



# **Proceedings of the Workshop on European Collaboration for the Management of Spent Nuclear Fuel and Radioactive Waste by Technology Transfer and Shared Facilities**

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## EXECUTIVE SUMMARY

The management of spent nuclear fuel (SNF) and radioactive high level waste (HLW) involves conditioning, transport, storage and geological disposal, with the overall objective of preventing the release of radionuclides to the biosphere over a very long time scale. Geological disposal is widely seen as the most realistic long-term solution. Much progress has been made in Europe over the past decades to develop such solutions.

Nuclear waste is produced by a large number of Member States of the European Union, but the amounts of high-level waste and spent nuclear fuel differ significantly. Although the responsibility for taking care of the radioactive waste lies with the individual Member State, it is obvious that the implementation of long-term solutions would benefit from working together. For the European Commission it is a priority that all Member States develop and implement long-term solutions for their radioactive waste.

Two European Commission projects were intended to explore different collaboration models in radioactive waste management, namely the projects SAPIERR-1 and -2 that looked into the possibility of establishing regional repositories, and the project CATT that explored the scope for technology transfer between Member States under the assumption that each country has its national repository.

This report summarises the events and conclusions of a workshop that intended to

- bring together the SAPIERR and CATT project partners, as well as other stakeholders, in order to explore the complementary aspects of the initiatives;
- facilitate the sharing of the main results of CATT and the interim findings of SAPIERR (which runs until November 2008), as well as the conclusions and experience from other organisations on Member State collaboration for waste management;
- discuss the state of knowledge and future needs and propose collaborations.

The Workshop arrived at an agreed catalogue of issues and opportunities that can be used to shape future collaborative actions. This catalogue was developed in brainstorming discussions and included SWOT-analyses of the ‘pros’ and ‘cons’ of the following actions that could potentially enhance cooperation between countries:

- Develop a EU pre-licensing system of generic disposal concepts and disposal technologies including common approach to structuring and assessing the safety case;
- Agree on a common regulatory framework, harmonisation of regulations, standards and infrastructure;
- Reach international agreements on short- and long-term liabilities, waste ownership and value of SNF;
- Develop a common approach to pre- and post-closure safeguards of spent fuel;
- Introduce a new EC Directive on radioactive waste management;
- Explore possibilities for small programmes to utilise facilities in large programmes;
- Formation of an alliance of waste management organisations (WMOs) to search for one site;
- Consider whether each member country of the alliance should be a potential facility host and membership requirement is a qualified willingness to become a host;
- Identify one member country of the alliance identified up-front as facility host;
- Identify technology for disposal and/or encapsulation that is to be transferred and associated financing schemes;
- Develop standardised approaches to geological disposal designs, containers, and safety cases;
- Promotion of exchange of experts between programmes with (EC) financial incentives;
- Develop URL for regional repository as first step towards regional repository;
- Definition of minimum data requirements on wastes for the purpose for shared repositories.

Based on the SWOT analyses the following tentative conclusions were drawn:

- There exist a number of well developed concepts for geological disposal that are ready to be implemented. A few of these are expected to be in operation in 20 years. Technology transfer from these programmes is expected to become an important tool allowing all European countries with radioactive waste to securely and safely dispose of it within a reasonable time horizon. Technology transfer is applicable for shared facilities as well when each country has its own national repository.
- Harmonized standards and criteria could offer benefits to achieve safe and secure disposal in all nuclear countries, but it may be counterproductive to impose a common set of regulations.
- Standardized technical concept and solutions would facilitate technology transfer. There is a risk, however, that standardized solutions would not be optimized with respect to the individual Member State's needs.
- Shared facilities could be an attractive option for many Member States with small or medium sized radioactive waste programmes. Shared facilities are complex social and economic constructions and the economic, logistic, safety and safeguard benefits need to be balanced against the more complex legal and social aspects. Projects for shared facilities may be based on the basis of a number of equal partners joining in, or on the basis that a small programme partner is joining a larger programme. In the first case all partners need to be willing to host facilities whereas in the second case the acceptance by the public in the hosting country is the major restriction. Shared facilities should never be a reason for a wait-and-see approach.
- The successful implementation of the most developed disposal concept is crucial for the safe and secure disposal in all European nuclear countries since it provides the basis for the technology transfer and would promote the public acceptance of geological disposal.
- It has to be ensured, however, that such technology transfer programmes do not stall the programmes that are well under way.
- Continuous support at the European Union level is crucial to further explore European collaboration for implementation of long-term waste management solutions by technology transfer and shared facilities.
- Shared facilities may be waste treatment and encapsulation plants, as well as repositories.
- It has to be acknowledged, however, that there may be legislative and political issues concerning the (permanent) import and export of wastes.

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# 1. INTRODUCTION

The management of spent nuclear fuel (SNF) and radioactive high level waste (HLW) involves conditioning, transport, storage and geological disposal, with the overall objective of preventing the release of radionuclides to the biosphere over a very long time scale. Geological disposal is widely seen as the most realistic long-term solution. Much progress has been made in Europe over the past decades to develop such solutions. Sweden and Finland are now preparing license applications for their disposal concept in crystalline rock, France, Belgium and Switzerland are moving ahead with their concepts for disposing conditioned waste in clay formations and Germany has come far with its concept of disposing radioactive waste in salt domes. In Sweden and Finland repositories are expected to be in operation by the end of the next decade, whereas the French repository is expected to be in operation a few years later. Nuclear waste is produced by a large number of Member States of the European Union, but the amounts of high-level waste and spent nuclear fuel differ significantly. Although the responsibility for taking care of the radioactive waste lies with the individual Member State, it is obvious that the implementation of long-term solutions would benefit from working together. For the European Commission it is a priority that all Member States develop and implement long-term solutions for their radioactive waste and the Commission has therefore funded a large number of successful research projects in this area.

Various European Union Member States are now entering a phase of implementation. Two Specific Support Actions: SAPIERR-1 (Support Action: Pilot Action for European Regional Repositories, <http://www.sapierr.net/>) and CATT (Co-operation And Technology Transfer on long-term radioactive waste management for Member States with small nuclear programmes, <http://catt.jrc.nl/>) and one Co-ordination Action SAPIERR-2 (Strategic Action Plan for Implementation of European Regional Repositories) have been undertaken within the 6th EC Framework Programme to explore how Member States with relatively small amounts of nuclear waste can implement long-term solutions through collaboration.

The objective of SAPIERR-1 was to explore the feasibility of regional European solutions for deep geological disposal, mainly in terms of shared repositories. SAPIERR-2 commenced in 2006 and its aim is to further develop the feasibility studies of SAPIERR-1 in order to propose a practical implementation strategy and organisational structures to create a formalised, structured organisation for implementing shared EU radioactive waste storage and disposal activities.

The overall objective of CATT is to investigate the feasibility of Member States with small nuclear programmes implementing long-term radioactive waste management solutions within their national borders, through collaboration for technology transfer with those Member States that have advanced disposal concepts. Although CATT assumes that each nuclear member state has its own repository, whereas SAPIERR assumes that there will be both national and also shared repositories in Europe, the two Actions are complementary.

Future collaborations models to support Member States with small amounts of radioactive waste may include:

- shared repositories with equal responsibilities, or shared repositories, where one Member State is the owner, but offers other Member States to join;
- national repositories but shared encapsulations plants or encapsulation in third country on commercial basis; and
- common technical concepts and shared technological know-how.

Irrespective of whether the repositories are shared or national, it is a very likely that the implementation will take advantage of the concepts that are already being developed for different geological formations. The scope for direct collaboration through, for instance, shared facilities or technology transfer from Member States with more mature concepts, will depend on technical aspects (such as type and amount of radioactive waste, available geological formations), economic factors (such as costs of transport, storage and disposal), legal and regulatory aspects (such as intellectual property rights, contractual and business options for international collaboration, waste transfer and export/import licences), planning and scheduling (such as the timing for disposal and long-term storage), and, importantly on the public and political acceptability.

The key purposes of the Workshop were to:

- bring together the SAPIERR and CATT project partners, as well as other stakeholders, in order to explore the complementary aspects of the initiatives;
- facilitate the sharing of the main results of CATT and the interim findings of SAPIERR (which runs until November 2008), as well as the conclusions and experience from other organisations on Member State collaboration for waste management;
- discuss the state of knowledge and future needs and propose collaborations on
  - the technical and economic requirements for implementation of shared facilities (disposal, storage and encapsulation);
  - the technical and economic aspects for implementation of technology transfer between Member States for storage, encapsulation and disposal;
  - non-technical aspects of shared facilities and technology transfer (national and international legislation, public acceptance, commercial aspects etc.).

The Workshops objective was to arrive at an agreed catalogue of issues and opportunities that can be used to shape future collaborative actions.

## **2. Structure of the Workshop**

The Workshop consisted of technical presentations by CATT and SAPIERR partners as well as presentations by technical experts and policy makers covering other aspects. Invitations were extended also to representatives of the major US and Russian projects that are considering offering fuel take back services to smaller countries. Presentations by representatives of the European Commission and of the IAEA were also included.

The Workshop participants were split into three groups to discuss the technical and regulatory, as well as the economical and societal aspects of collaboration through shared facilities and technology transfer. The breakout sessions were structured into a brainstorming part and into a SWOT (Strengths-Weaknesses/Opportunities-Threats) analysis part. The conclusions from the breakout session groups are reported in the following.

The Workshop agenda is given in Annex 1, a list of participants in Annex 2, and the presentation are reproduced in Annex 3.

### 3. Summary of the Presentations

#### 3.1 *Opening Presentation: International Collaboration on Long-Term Waste Management*

CHARLES McCOMBIE (ARIUS Association, Switzerland)

Radioactive waste management has traditionally been characterized by international collaboration through various fora. Key cooperation areas include:

- development of strategies and concepts;
- knowledge exchange;
- development of methodologies including theoretical methods as well as supporting experimental work;
- joint research projects;
- provision of services;
- communication with free exchange of information; and
- co-operation on waste management facilities.

With the exception of reprocessing and waste conditioning this collaboration has been to a large extent non-commercial. This has been in particular the case for knowledge exchange through international organisations such as IAEA and NEA. The EU projects, which have been partly funded by the European Commission, were an important driver for European cooperation. There has been also a large number of multi-lateral projects, where different organisations shared data through contributions in-kind, or where the participants committed themselves by sharing information or conducting joint projects and associated activities. The international research facilities, in particular the underground research laboratories (URL), have often been a focal point for such collaboration. As a result of this collaboration there now exists a large body of shared results and knowledge.

Nevertheless, there has been (and is) significant duplication between national programmes and also international programmes. This may not be a major problem though, as each country is responsible for its own waste. Although the international collaboration has been very beneficial there could also be some potential drawbacks such as:

- competition for scientists;
- reduced political and financial support for national programmes;
- not all concepts are transferable;
- truly independent review of national programmes could be at stake; and
- limited freedom of thought – less ‘outside the box’ thinking.

A number of countries are now entering the implementation phase of geological disposal. This will probably lead to a shift in the direction of the international collaboration towards:

- greater regulatory harmonisation,
- increased education and training,
- technology transfer,
- more emphasis on commercial services,
- standardized technologies, and
- shared facilities for conditioning, encapsulation and disposal.

This Workshop addresses primarily these future directions. The full spectrum of collaboration possibilities need to be addressed to fulfil the common goal which is to ensure that all European



countries have access to safe and secure geological repositories on appropriate time-scales. But we must not forget that these must be achieved within certain constraints:

- must be based on state-of-the-art technology;
- must be affordable;
- the implementation needs to be a ‘fair’ deal for all parties; and
- no country should be compelled to accept foreign waste, but any country should have the possibility to accept.

## **3.2 Activities in the European Commission**

### **3.2.1 Technology Transfer in EC funded R&D on Geological Disposal**

*GIOVANNI DI BARTOLO (EC, DG-RTD)*

Technology transfer classically has been associated with the diffusion of technologies and processes across national boundaries. But in recent years, the term has been attached with equal significance to the flow of ideas and knowledge within and between organisations within the same economy or nation. When the organisations involved are business corporations and government agencies, the term knowledge management is often used as a synonym for the act of transfer or diffusion. Knowledge management in and between Member States contributes to the goal of making Europe the most competitive and dynamic knowledge based economy in the world (Lisbon Strategy, [3]).

In the Euratom FP7 ‘Fission programme’ [4] in general and geological disposal in particular, knowledge transfer is embedded in the objectives to

- promote safer, more resource-efficient and competitive exploitation of nuclear energy, and to
- underpin the development of a common European view on the main issues.

Knowledge transfer is explicitly foreseen in the training and dissemination activities. Knowledge management in geological disposal includes

- direct transfer and integration (e.g. CATT),
- protection of intellectual property rights and cross-border licensing of technologies,
- transfer of liabilities (malfunctioning of transferred technologies or supplied components),
- harmonisation of regulations,
- indirect transfer and integration (e.g. in CATT and SAPIERR) through technology transfer or shared repositories.

A Technology Platform (TP) on geological disposal could be a good instrument of coordination. The TPs belong to their stakeholders, not to the EC. The EC supports the creation and operation of the TPs when it fits with the objectives and policies of the EU. Stakeholders (here a high-level group of relevant personalities), usually led by industry, come together to agree on a common vision for the technology. They define a Strategic Research Agenda (SRA), setting out medium and long-term objectives for the technology. They also develop a deployment strategy and implement the SRA with the mobilisation of significant human and financial resources.

A Geological Disposal TP would bring together all key stakeholders (research organisations, regulators, technical support organisations), driven by waste management organisations, to carry out ‘implementation oriented’ activities, with the largest possible degree of transfer and integration.

### 3.2.2 EC Radioactive Waste Management Policy

*WOLFGANG HILDEN (EC, DG-TREN)*

The World's nuclear programmes have taken off, but no runway for landing is in sight in many countries around the World. The EUROBAROMETER [5] indicates that 92% of the population would advocate addressing solutions for the waste problem now and 91% think that it is high time for MSs to set appropriate deadlines. On the other hand, 81% consider the political decision unpopular and 79% believe that no safe solution has been found yet. Implementing a final solution for the radioactive waste management problem would reduce the 55% aversion against nuclear power to 31%.

The not-adopted, 2004 Draft Directive on the 'Safe Management of Spent Fuel and Radioactive Waste' stipulated that "Each Member State shall establish and keep updated a clearly defined national programme for the management of radioactive waste that includes all radioactive waste under its jurisdiction and covers all stages of management." It also stipulated that "Member States shall study the possibility to give priority to the solution of deep geological disposal, taking due account of their specific circumstances."

The European Council on 8 May 2007:

- concluded that strategies for the safe management of all types of spent fuel and radioactive waste need to be developed,
- urged each EU Member State to establish and keep updated a national programme for the safe management of radioactive waste and spent fuel that includes all radioactive waste under its jurisdiction and covers all stages of management, and
- supported the establishment of a High Level Group at EU-level aimed at furthering a common approach to radioactive waste management.

In a 3 July 2007 European Parliament hearing Commissioner A. Piebalgs explained that since 1994 ~200 M€ had been spent on the appropriate Framework Programmes. It is now time for the Member States to implement disposal solutions for HLW without further delay. The example of Finland demonstrates that even countries with small programmes can afford their own national repository, if research is shared with others to minimise cost (e.g. through the Äspö underground research laboratory). Proposals from non-EU states for disposal of waste and spent fuel should not be encouraged for technical, economical and also safety and security reasons. This holds in particular, when the potential receiving state has not put in place the same technical, political and societal requirements and conditions as given at EU level. Regional solutions may be appealing in terms of economy of scale, but countries must be found that are willing to host such a regional centre. In no way should the hope for regional solutions be used as an argument for a wait-and-see policy. Instead, each MS should actively seek solutions on its own territory.

Implementation of deep geological disposal is an essential condition for the continued use and potential expansion of nuclear power. All initiatives leading to encouraging and facilitating progress towards identification and operation of waste repositories are therefore highly welcomed by the EC. The FP project CATT and the joint use of URLs are important to prevent reinventing the wheel.

The example of Finland shows that from inception to operation it can take 40 years. Therefore 'wait-and-see' is not a good strategy. If one is dreaming of a regional repository, one should start with the notion that the repository would be in one's own country.

### **3.2.3 SAPIERR I and II - European concepts for shared storage and disposal facilities for radioactive waste?**

EWOUDE VERHOEF (COVRA, The Netherlands)

The overall objective of the EC funded projects SAPIERR-1 (2003-2005) and SAPIERR-2 (2006-ongoing, [www.sapierr.net](http://www.sapierr.net)) is to assist the development of shared facilities regional or international facilities for storage and disposal of radioactive waste. Shared facilities is clearly an attractive option for countries for which it is difficult to develop national solutions due to limited financial or technical resources or research capacity, or when there is no suitable geological formation available. Shared facilities is also of interest for countries that do not have these limitations but see it as an opportunity for economic optimisation through economy-of-scale or more productive use of public funds. SAPIERR-1 was devoted to pilot studies on different options for regional repositories in Europe and included research and technical aspects as well as legal and regulatory issues. The pilot studies included one or two repositories with spent fuel and high-level waste and also long-lived waste. The SAPIERR-1 Project concluded that there is a large benefit from regional repositories, in particular as regards economy, but that efforts need to be increased, if regional repositories were to be implemented in the coming decades.

The objectives of SAPIERR-2 are to:

- define in more concrete terms the organisational framework through a modestly sized, self-sufficient European Development Organisation (EDO);
- clarify the legal, economic, safety and security and societal aspects of shared facilities, and
- present the results and recommendations at workshops.

These issues will be addressed in different work packages. In addition to the EDO there will also be much emphasis on the public and political attitudes towards regional repositories both at national and local level.

The participants in SAPIERR-2 foresee three potential outcomes:

- the establishment of an EDO;
- the requirement for further studies, or
- for the time being no further efforts are to be expended.

### **3.2.4 'CATT' - A project on Co-operation and Technology Transfer on Long-Term Radioactive Waste Management for EU Member States with Small Nuclear Programmes**

JOHN MATHIESON (NDA, United Kingdom)

The starting point for the CATT project (2006-2007) is that geological disposal is the desirable waste management end-point, and that each nuclear waste-owning Member States need to have a repository within their national borders. Some countries such as Sweden, Finland and France are quite advanced and are now entering the implementation phase, whereas other countries have only reached a conceptual stage and may often also lack the financial, human and technical resources to develop repositories in the mid-term future. This problem could be overcome, if the countries with less developed programmes (Technology Acquirers) could take advantage of the knowledge and investments made in countries at a more advanced stage (Technology Owners). Although some countries could be clearly identified as TO (e.g. Sweden) or TA (e.g. Slovenia), various Member States could be either (e.g. UK).

The specific objectives of CATT were to:

- explore the viability of technology transfer between large and small programmes;
- analyse radioactive waste management (RWM) steps and recommend TT solutions;
- develop ‘collaboration’ models between countries; and
- propose future demonstration project in EU.

In addition to the technical issues, such technology transfer also needs to take into account government policies, legal aspects and commercial interests — for instance intellectual property rights and financial return for TOs. At the start of the project information was gathered on the waste management situation in all EU Member States with nuclear electricity production. This information was then used as basis for a first feasibility study where a large number of issues were analysed. Based on this study a more detailed analysis with emphasis on waste encapsulation was carried out. To this end five scenarios were investigated: i) a national encapsulation plant in a TA country, ii) using an existing encapsulation plant in a TO, iii) a new EP at a reprocessing plant and iv) a shared encapsulation plant for TA countries, v) long-term storage. The CATT project concluded that:

- For TA countries with SNF quantities of a few thousand tHM it should be feasible to implement national encapsulation and disposal facilities using money generated by electricity sales and by profiting from technology transfer. This view is supported by the case of Finland that has only four reactors and has benefited from collaboration with Sweden.
- A CATT-style technology transfer has the potential to reduce the costs of national waste management facilities for long-term storage, encapsulation and disposal. This is because technology transfer would reduce the need for detailed research and development into the design of plant and equipment; also, designs could be simplified to make them commensurate with the smaller volumes of waste to be handled. Differences in fuel type and disposal geology will mean, however, that some additional development work will always be necessary.
- Where two or more countries have similar fuel types and similar disposal environments, significant cost savings may also be possible through the creation of a shared encapsulation facility. Alternatively, where a Member State has decided that SNF is to be exported for reprocessing, cost savings could be made by the customer (and added value created for the reprocessor), if the reprocessing plant were to offer encapsulation as an additional service.
- In general, however, existing and currently planned encapsulation plants will not have the spare capacity and/or the capability to offer an encapsulation service to other Member States. A possible exception could occur where the customer has only a small quantity of SNF that was of the same type as that normally handled by the plant.

Looking into how technology transfer (TT) might be further developed within the EC 7th Framework Programme, it was proposed as CATT-conclusion to consider a complete feasibility study for TT from interested TO to an interested TA. The TT would encompass national encapsulation and repository facilities. The feasibility study would aim to cover the complete decision-making process regardless whether it would be used or not in a specific case.

### **3.3 Supporting International Activities**

#### **3.3.1 Fostering waste management information exchange and fuel repatriation**

*NEERDAEL, B. (IAEA, NEFW/WTS)*

With respect to the topics of the workshop, there are two relevant Sections within the IAEA: the Waste Technology Section (WTS) is concerned with confidence building and technology transfer, while the Nuclear Fuel Cycle and Materials Section (NFC) is *inter alia* responsible for a programme of

repatriation of spent fuel from research reactors. Both Sections form the Nuclear Fuel Cycle and Waste Technology Division.

The IAEA has a number of activities ongoing in relevant fields, such as the development of documents on

- design and planning of geological repositories,
- public/political acceptance of geological disposal,
- retrievability and its technological impact,
- application of numerical modelling to geological disposal programmes,
- training and development of HLW disposal technologies,
- viability of sharing disposal facilities.

A major IAEA instrument for co-ordinating research, knowledge transfer and training is the Network of Centres of Excellence for the use of underground research facilities (URFs). This Network brings together a wide range of donor and recipient countries. Training courses at such URFs have since 2003 covered subjects such as:

- methodologies for geological disposal (fundamentals, theory, practice),
- site selection procedures and methodology,
- decision making and stakeholder involvement,
- repository design, construction and operation ,
- numerical simulation of subsurface processes,
- deep geological repositories in sedimentary environments, and
- transport and retardation processes in fractured rocks.

While these courses provide extensive theoretical underpinning and hands-on training, placement of fellows in various URF projects allows more in-depth training and participation in the respective programmes.

These activities also cater for the increasing demand world-wide to take stakeholder views into account and to mobilise resources at international level. The IAEA has been championing multi-national approaches to waste disposal for reasons of economy-of-scale, environmental and safety considerations, as well as easier regimes of security and safeguards. To date, however, no scheme has been put into place due to the lack of suitable hosting volunteers. Accordingly, hosting scenarios and their pre-conditions need to be further investigated. Nevertheless, transboundary waste transfers look back to a 30-year history, but do not involve final disposal. Currently, the viability of sharing disposal facilities and the key issues associated with it are being investigated.

On the other hand, the programme to foster repatriation of spent fuel from research reactors (RRs) has gained momentum due to a non-proliferation policy-motivated shift from highly-enriched uranium (HEU) to low-enriched uranium (LEU) in RRs. Spent fuel is mainly shipped back to the USA and Russia.

### **3.3.2 Safety, Amenity, Enmity**

*O'CONNOR, M. (Université de Versailles St-Quentin-en-Yvelines, C3ED, France)*

Long-term management solutions for radioactive waste and spent nuclear fuel are a terrain of confrontation and integration and are a challenge of sustainable territorial development. Sustainability is the pre-occupation — scientific, economic, moral and political — for reconciliation and coexistence of interests and forms of life that are in conflict with each other and at risk. Long-term stewardship for

waste disposal sites is one of the terrains where these tensions are expressed and where experiments may be made for their reconciliation.

### ***Theme A — Building Durable Relationships with Radioactivity***

The continuing presence of the waste is bothersome and requires a societal response. Often, there is a feeling that, precisely because this lurking ‘risk’ is not easily forgotten, a solution that inspires confidence must engage a permanent vigil in which concerned stakeholders are directly involved. This may involve stewardship procedures whereby an economically active community, in partnership with overall regulatory authorities, is living close to (or within) and maintaining a watch over the waste disposal site. Strategies for living with radioactivity must be built on three key aspects:

- technical and scientific expertise;
- building social/societal relationships with the site;
- political and economic partnership.

This social dimension cannot be deduced from the technology, the medical or the physical information set. This is why communication amongst stakeholders, and between technical experts, decision makers and civil society, is essential.

### ***Theme B — Building Stakeholder Dialogues***

In order to assess to what extent or on what basis the members of a society will judge acceptable (or not) a given radioactivity management strategy, it is necessary to consider the meanings and relationships (in social, economic, cultural and symbolic terms) that alternative remediation and stewardship strategies might establish between the people implicated in the stewardship process. Stakeholder dialogues cannot eliminate conflicts, complexities and uncertainties. But they can be used to help build up a clear picture about the merits and demerits of waste/site stewardship alternatives that present themselves to the relevant authorities and stakeholders in the society. Three points must be addressed in order to build a structured stakeholder dialogue process:

- First, there must be an explicit identification of the relevant stakeholders, and the establishment of an institutional framework within which exchange of information and opinions can take place.
- Second, there must be a clear picture of the relevant site management options.
- Third, there must be a clear expression of the criteria for selection of the management strategies, with a variety of different criteria reflecting the full diversity of societal concerns.

Sustainability is the preoccupation — scientific, economic, moral and political — for reconciliation and coexistence of interests and forms of life that are in conflict with each other and at risk. Every organism, species or cultural form affirms its specificity and its survival needs in relation to the rest of the world, while at the same time inhabiting (and depending on) that world in its richness and diversity. In the case of radioactive wastes, which are our own creation, we can hardly treat them as our enemy, yet must be respectful of the dangers that they pose. So an attitude of friendly watchfulness seems called for.

Long-term radioactive legacy management is a recursive multi-stakeholder process that requires

- mobilising knowledge and material resources;
- developing and using analytical frameworks (e.g., models, maps, sets of scenarios);
- framing normative assumptions (e.g. indicators & reference values for multi-criteria assessment);
- *ex post* or *ex ante* evaluations of policy and performance;
- negotiating purposes and communicating results.

Well structured participatory processes in decision making can help with:

- identification and development of elements of common problem definition and common language for all the parties concerned;
- understanding of the assumptions underlying expert solution proposals and evaluation techniques, of the terms in which these techniques can contribute to reasoned decisions, and limitations to their application;
- sharing of reasons and justifications brought by different social groups;
- status and respect given to participation by professionals and lay people.

### **3.4 International Projects on Implementation**

#### **3.4.1 SKB/POSIVA A LIVING COLLABORATION**

*JUHANI VIRA* (POSIVA Oy, Finland)

Finland has a relatively small nuclear programme with four nuclear reactors in operation. In 1978 Finland conducted feasibility studies for geological disposal. The main route was then re-processing but the high cost of reprocessing and the uranium price collapse led to a government decision in 1983 when direct disposal was singled out as the solution, with a repository in operation by 2020. Or, the spent fuel should be sent abroad for ultimate disposal or reprocessing, which, indeed was initially the case for the spent fuel from the Loviisa NPP. For the spent fuel from the Olkiluoto NPP, the owner, TVO, decided to take advantage of the concept developed by SKB in Sweden. This was quite logical, since the Swedish and Finnish bedrocks are quite similar and the two Olkiluoto Finnish reactors use fresh fuel from Sweden. The Finnish reactor operators, TVO and IVO, adopted the KBS-3 concept in 1985. The early collaboration was between TVO, IVO and SKB, but was later transferred to POSIVA. The collaboration has gradually increased in both, scope and intensity from 1987 until today. The early years of collaboration concentrated on concepts and research (for instance through Äspö URL). In 2001 the collaboration intensified with focus on encapsulation and repository technology. The aim was to have a win-win situation to exploit SKB's developments in encapsulation and repository technology and POSIVA's siting experience. The collaboration was further strengthened in 2006 and includes now all areas of geological disposal as well as agreements on ownership, liabilities, intellectual property etc. The feasibility study of horizontal disposal (KBS-3H) and welding techniques for copper canisters are two representative examples. For copper welding POSIVA will further develop electron beam welding as their main method and in parallel SKB will develop friction stir welding; thus complementarity will be achieved. So far there have been more than 80 joint projects. These have led to cost savings and early awareness of issues as well as a larger data basis and broader expertise for planning of future work and helped to develop arguments for safe disposal. As a positive side effect of the SKB-POSIVA collaboration is that it has also led to closer co-operation between the regulators.

Although the collaboration has been very positive there are also some smaller problems encountered such as:

- different time tables and different regulations led to different priorities and requirements; for such reasons there has been relatively limited collaboration in safety case development and site investigations
- there is a certain imbalance in expert resources with POSIVA as the smaller partner;
- different organisational structures have in some cases led to strains in practical co-operation.

The main conclusions from POSIVA's view point are:

- the programme for geological disposal is possible without excessive costs;
- POSIVA owes much of its success to international collaboration and then in particular with SKB;
- international collaboration has allowed POSIVA to focus its own work on site specific topics.

The SKB/POSIVA co-operation has been successful. In general successful collaboration requires that:

- each partner has its own programme of a sufficient level of maturity;
- the ties resulting from collaboration need to be acknowledged and accepted;
- differences in national context must be acknowledged and may increase as the number of partners increases.

### **3.4.2 SMALL NUCLEAR PROGRAMMES' NEEDS**

IRENA MELE (ARAO, Slovenia)

There is no unambiguous definition of 'small nuclear programme'. It is usually related to small number of nuclear power plants but it sometimes also refers to small countries. Irrespective of the definition Slovenia obviously qualifies as a 'small nuclear country'. In addition to small amounts of waste, small programmes are also hampered by absence of nuclear industry, limited human and financial resources, and limited technical capabilities and research potential. Yet the small nuclear programmes are expected to provide a national waste management solution that fulfils the same safety standards and requirements, which should be based on international practice. They are also required to develop nuclear legislation, to establish a national Safety Authority, and to provide qualified staff. The cost for disposal per ton of spent fuel is much higher for small programmes and this cost has a tendency to increase. For example the estimate for Slovenia increased from 0.29–0.42M € (equivalent)/\$/tU in 1996 to 0.82M €/tU in 2004. This cost does not include research or development and assumes ideal conditions. The costs for R&D are very high for small countries and it is for instance impossible to finance underground research laboratories that may be needed to support the construction of a repository. Another problem is that there is not an urgent need for a repository and it is therefore difficult to get the necessary financial and political support. Participation in international R&D programmes is essential for the small programmes but the limited resources make it difficult to participate. The consequence is a vicious circle where the small programmes depend on the large programmes — and need to follow their decisions, which may have large consequences for the small programmes.

From the small programmes' perspective:

- it would be very helpful if options could be kept open and final decisions deferred until a final solution is agreed upon;
- pooling of programmes and shared facilities (SAPIERR model) could be a way forward but the many practical problems needs to be resolved, there has to be an interest to host a shared facility and it must be supported by the large programmes;
- the support from the developed programmes (Technology transfer à la CATT) is needed in the form of ready-made products, services, knowledge transfer and training.

It is important to stress that successful implementation of geological disposal in the developed programmes would also be very helpful for the small programmes.

As regards new-build of reactors, small programmes are faced with a 'Catch 22 problem': large-disposal costs prohibit the economic feasibility of new reactors, but without new reactors there will be no critical mass to carry out a disposal programme.

Co-existence of both purely national and shared solutions that are beneficial for the small as well as the large programmes is possible. Whatever the solution is, the small programmes will need support from the large programmes for the complete fuel cycle — not as a 'free lunch' but at a fair price.



### **3.4.3 WHAT THE TECHNOLOGY OWNING COUNTRIES CAN OFFER AND WHAT THEY MIGHT WANT IN RETURN**

ALAN HOOPER (United Kingdom)

Technology owners can offer support in terms of technology, skilled personnel and services. Technology transfer from waste management organisations may include hardware, designs and drawings, software and quality systems; skilled personnel could encompass technical experts as well as managers. Services that could be offered include encapsulation, reprocessing, transport and special R&D facilities. In addition TO countries could also provide support for the regulatory aspects and stakeholder networks. The TO countries should also open up their networks for TA countries.

It is important that there is a win-win situation. The TO countries need to be compensated for their costs but technology transfer is not just an ordinary business arrangement. Timing is a critical aspect. The TO countries need to support TA at the early stage of the programme, but it will be difficult for TO to set aside resources in periods of, for instance, licensing.

### **3.4.4 MODEL FOR SHARING AND TRANSFER OF KNOWLEDGE IN THE FIELD OF RWM — BOTH, NON-COMMERCIAL AND COMMERCIAL**

MONICA HAMMARSTRÖM (SKB, Sweden)

The Swedish nuclear waste programme (KBS) started in 1978 and in 1985 the KBS-3 concept was approved to grant the license for the most recent Swedish reactors. Since the early eighties there has been a continuous development of the Swedish programme with CLAB, Äspö URL and the canister laboratory as important corner stones. The development has been harnessed by the review of SKB's R&D plans on a regular basis. In 2006 SKB submitted its license application for an encapsulation plant and in 2009 the license application for the construction of a repository in crystalline rock will be submitted. The repository is planned to be in operation by 2020.

International collaboration has been an important part of SKB's development from the start with the international STRIPA project (1980-1992) as an early success story. The Äspö URL is now a focal point for international bi and multi-lateral collaboration. SKB sees three levels of co-operation models:

- activities mainly for information exchange;
- project agreements for instance Äspö projects or modelling task force for high-level scientific support to the Swedish R&D programme;
- cooperation agreements as with POSIVA.

SKB recognized at an early stage that there is a demand for support from SKB to other countries on a more commercial basis. SKB's waste management programme is funded through the Swedish Nuclear Waste Fund, which can only be used for the development of solutions to the management of waste from the Swedish nuclear power programme. An international service organisation was therefore set up in 1984 to manage international consulting services and to allow fair pay-back of investments made by SKB's owners. Since 2001 SKB IC is a separate legal entity, but fully owned by SKB.

As a conclusion, SKB's opinion is that

- open information will be important in the future for technical and political reasons;
- on the other hand co-operation related to detailed designs and licensing imply that technical solutions are of commercial interest;
- a reasonable balance between open information and commercial aspects need to be guaranteed.

### **3.4.5 MANAGEMENT OF HLW AND LILW-LL IN BULGARIA**

RADOSVETA MARKOVA-MIHAYLOVA (BNRA, Bulgaria)

The main generators of radioactive waste in Bulgaria are the Kozloduy nuclear power plant (plus possibly one new plant) and nuclear applications, such as medicine, materials testing and research. Bulgaria has already in place a comprehensive regulatory regime for radioactive waste. The management routes for the waste depend on its category, whereby long-lived intermediate level wastes (LILW) and high-level wastes (HLW) are destined for final disposal in a geological repository. It is planned to have spent fuel reprocessed in Russia and the resulting vitrified HLW returned to Bulgaria for disposal. Currently all operational HLW is stored in an underground shaft near the Kozloduy NPP. Sealed spent sources are currently stored at the Novi Han repository awaiting the decisions on geological disposal.

The current policy is to develop a national solution for geological disposal, the concepts for which should be completed by 2012. Following a period of site selection and site assessment, a final decision on a site is expected to be taken in 2015. Site selection and site assessment have been on-going since the late 1970s and comprehensive body of data has been collected. However, the necessary decision making processes and criteria have not yet been developed.

## 4. Working Group Discussions and SWOT Analysis

The Workshop participants were split into three groups that addressed technological, regulatory and legal, and socio-economic aspects respectively. In brainstorming exercises lists of topics relevant to the collaboration towards implementation of long-term waste management solutions were developed by each of the three groups. A shortlist of further actions for each group was then derived from the topics lists. These actions were subsequently subject to a SWOT analysis. A SWOT analysis is strategic tool to evaluate the Strength, Weakness, Opportunities and Threats of an action or a project. The SWOT analysis is a two-dimensional mapping of attributes that are relevant to the action and which could be viewed as helpful or harmful or as external or internal. An attribute is considered as a:

<b>STRENGTH</b> if it is helpful and internal	<b>WEAKNESS</b> if it is harmful and internal
<b>OPPORTUNITY</b> if it is helpful and external	<b>THREAT</b> if it is harmful and external

### 4.1 Regulatory Aspects

#### 4.1.1 Summary of brainstorming discussion

In the various group sessions, the following points were recognised as aspects of importance for improving the regulatory regime with respect to waste disposal solutions:

##### *Policy decisions for guiding waste management solutions*

- Link licensing of new nuclear power plants with geological disposal (as is the case in some national regulations);
- All calls for harmonisation in radioactive waste management should be implemented under a renewed Euratom treaty;
- Harmonise (on EU / IAEA level) regulatory approaches and standards with those for other hazardous wastes (especially where there are conflicts), and emissions / wastes from other electricity generation systems;

- International agreement on short-term and long-term liabilities and waste ownership;
- Requirement for EU programmes to have a long-term plan;
- Declare that spent fuel is not a waste so that it requires different management routes;
- Agree on a common approach to pre- and post-closure safeguards of spent fuel;
- Agree with respect to liabilities on how to share value of any retrieved spent fuel;
- Establish waste equivalency standards for exchange / transfer of waste at EU level;
- Re-visit ‘banning’ conventions (e.g. LDC – sea dumping);
- Agreement on transfer of responsibilities and liabilities in the pre- and after-closure period for shared facilities.

***Putting nuclear waste management into the wider context in order to increase efficiency***

- Pre-licensing of generic disposal concepts,
- Pre-licensing of specific disposal technologies,
- Common approach to structuring and assessing the safety case at all stages of repository development,
- Common criteria and benchmarks for disposal site selection,
- Harmonisation of procedures for site selection,

***Facilitating the implementation of solutions***

- Establish network of international stakeholders (like regulators' group) to devise new ideas,
- EU standard on community benefits packages,
- Harmonize EU regulations and standards on a long-lasting basis (= to programme lifetimes) and ensure resilience to changing radiological protection thinking,
- Establish minimum legal requirements and framework for shared facilities,
- Establish how to share liabilities for any new nuclear power plants that supply several countries,
- Harmonised waste acceptance criteria for shared facilities,
- Develop EU inventory of radioactive wastes,
- Harmonised approach to timeframes in regulations,
- Harmonised quality management systems in radioactive wastes management,
- Harmonize approaches to when and how to close repositories.

#### 4.1.2 SWOT Analyses

From the list of topics developed in the brainstorming sessions the following (aggregated) topics were subject to a SWOT analysis:

<b>EU pre-licensing system of generic disposal concepts and disposal technologies including common approach to structuring and assessing the safety case</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"><li>• Will speed up licensing</li><li>• Gives confidence to national regulations</li><li>• Easier to interact with other national experts</li><li>• Economy of scale, if many are using same system</li></ul>	<ul style="list-style-type: none"><li>• ‘One size fits all’-approach may be too inflexible</li><li>• May lead to ‘over-design’</li></ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"><li>• Business opportunity for system ‘owners’</li><li>• Would provide clearly defined Europe-wide system for businesses to develop equipment and components</li></ul>	<ul style="list-style-type: none"><li>• May not match state of development of other national programmes</li><li>• If design is defective, it would result in ‘common cause’ problems in all Member States</li><li>• An additional step in license development could cause delay for some more advanced national programmes</li><li>• Discourages innovation and development</li></ul>

**Conclusions:** There appear to be considerable benefits from such harmonised approaches, provided efficient mechanisms are put into place that prevent the effects to occur that are listed under ‘weaknesses’ and ‘threats’. To the outside observer, it appears anomalous that there is not a greater unity of approach in the EU. The scientific and technical challenges posed by waste disposal are common, public and political attitudes do not vary very widely. With respect to the technologies involved, there may be some reluctance to standardise to the concepts chosen by the leading programmes since these have often been developed from 1<sup>st</sup> generation concepts that have not yet been optimised in an economic sense. With safety case preparation, the opportunities for developing a common approach may be greater. Some progress has been made by the NEA/OECD in this respect, but the guidance produced there may not yet be completely applicable in practice. Major EU programmes have recently submitted safety case documents that diverge from the NEA approach and differ from each other. A dedicated effort to improve this situation would be valuable.

<b>Common regulatory framework, harmonisation of regulations, standards and infrastructure</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Common <b>standards</b> could be useful</li> <li>• Facilitates exchange experience</li> <li>• Increases public confidence</li> <li>• System is more predictable and longer-lasting</li> <li>• Makes processes more secure for the implementer</li> <li>• Pre-defined staged programmes are easier to cost</li> <li>• Could provide framework for resolving international disputes/differences</li> </ul>	<ul style="list-style-type: none"> <li>• Common <b>regulations</b> may give rise to problems</li> <li>• It may be difficult to overwrite national history of regulatory development</li> <li>• Too complicated for some countries with limited requirements / needs</li> <li>• May not suit well all national geological or geographical situations</li> <li>• Adds additional layer of bureaucracy</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Removal of politically driven items in national regulations</li> <li>• Streamlining national regulatory system and make it more efficient by relying on common EU system</li> <li>• Development of regulatory infrastructure in countries with a poor one</li> </ul>	<ul style="list-style-type: none"> <li>• Danger of adopting ‘hardest line’ and consequently over-regulating</li> <li>• Usurping national authorities</li> <li>• May be so broad as to be easily challenged by protesters</li> <li>• Simple cases may be treated the same as complex ones – increasing the burden</li> <li>• Weak national authorities may have system thrust upon them</li> </ul>

**Conclusions:** Given the varied state of development of the regulatory framework in MSs, it may be difficult or even counterproductive to impose a common set of regulations. However, glaring differences in key parameters such as allowable dose or risk limits are confusing for experts and members of the public alike. A harmonised set of standards would facilitate international collaboration and trust by stakeholders. In this regulatory area, a number of bodies are involved, e.g. IAEA, WENRA, the NEA regulators forum, national regulatory bodies etc. The IAEA, for instance, is moving towards promotion of re-structured and harmonised safety standards. Any harmonised EU standards would have to match these global developments. A dedicated effort to improve this situation would be valuable, building on recent WENRA and EC work.

<b>International agreement on short-term and long-term liabilities, waste ownership and value of spent fuel</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Facilitate trade/ sharing and would be essential for shared facilities</li> <li>• A model template would be useful provided not too prescriptive (i.e. guidance and could have options indicated)</li> </ul>	<ul style="list-style-type: none"> <li>• Hard to achieve</li> <li>• Potential for political interest to over-ride technical matters</li> <li>• Difficult/impossible to enforce</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Spin-off to conventional waste management</li> <li>• Application of long-term European perspective to otherwise local arrangements</li> <li>• Harmonisation with other environmental, non-nuclear legislation</li> </ul>	<ul style="list-style-type: none"> <li>• Could discourage countries from hosting facilities, if not properly formulated</li> <li>• Possible impact on many other areas of legislation (e.g. resource and land ownership, pollution problems, environmental legislation)</li> </ul>

**Conclusions:** Such agreements appear to be the basis for shared repositories, but certainly will be difficult to bring about and to enforce effectively. With the current increase in interest in introducing nuclear power to new MSs and with indications that some new NPPs could be shared between MSs, this is becoming a topical issue. An interdisciplinary study involving both technical experts and legal specialists could be of value.

<b>Common approach to pre- and post-closure safeguards of spent fuel</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Difficult issues become more transparent</li> <li>• Clarifies construction / operation requirements for repository</li> <li>• Would clarify overall safeguards</li> </ul>	<ul style="list-style-type: none"> <li>• Difficult to achieve consensus</li> <li>• Weapons states have to agree with non-weapon states</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Increased communication between WMOs and safeguards community</li> <li>• Updating and widening scope of Euratom treaty</li> <li>• Clarification of post-closure monitoring requirements and objectives</li> <li>• Intensification of safeguards regime and extension to smaller programmes outside EU</li> <li>• Would make regional SF repositories more attractive as safeguards would be easier to enforce</li> </ul>	<ul style="list-style-type: none"> <li>• May interfere with national retrievability requirements</li> <li>• Increased disposal costs and extends the period of costs</li> <li>• Most restrictive scheme will be used</li> </ul>

**Conclusions:** Today there is much attention being devoted to security and safeguards challenges associated with the rise in nuclear power programmes. Initiatives outside of Europe (e.g. GNEP and GNPI) have been addressing these issues in association with new nuclear programmes. A sensible preliminary to this would be for the existing EU nuclear States to examine the consistency of their approaches. In fact, in the safeguards and security area, the focus is almost always on the front end issue of enrichment and the backend issue of reprocessing. However, the long-term management of spent fuel and high level waste must also be addressed. It must be recognised that safeguards only work as long as the signatory states are prepared to comply. Nevertheless, the transparency effected by more common approaches might work towards facilitating the implementation of waste management solutions.

## **4.2 Socio-Economic Aspects**

### **4.2.1 Summary of brainstorming discussion**

This group discussed what would need to happen in order to move forward the implementation of a potential regional solution under the following broad headings:

- assure political commitment (towards a solution);
- design a robust process (for implementation);
- how to make the project attractive (to stakeholders); and
- scenarios for a regional solution.

In terms of potential actions, within each of the broad headings, the group suggested the following potential actions:

#### **Assure political commitment through**

- introduction of a new EC Directive on radioactive waste management to encourage Member States to progress with national programmes or find joint solutions;
- taking advantage of the role of the ‘Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management’ [1] to encourage Member States to progress, as above;
- Waste Management Organisations (WMOs) becoming more proactive with the backing of a new Directive;
- examining the role of the existing ‘nuclear’ local communities, especially with respect to them becoming ‘preferred’ partners.

#### **Design a robust process by**

- reviewing the involvement of the regulators, enabling them to act as advocates for the community (as in the US);
  - for example, engender confidence building through safety case development;
- establishing clear procedures for stakeholder involvement;
- aiming to achieve an equal level of understanding amongst all stakeholders of issues through an agreed ‘education’ process for all;
- define site selection criteria up front, as in the AkEnd process [2] in Germany;
- making the project ‘attractive’ (see below);
- treating potential hosts as VIPs and not overlooking them in either the national or the transnational processes.

#### **Making waste management projects more attractive by**

- establishing a benefits package where:
  - benefits should be clear upfront;
  - it is acknowledged that economic benefits are not the only priority;
  - it is clear who should provide the package e.g. government, the EU or the implementer;



- acknowledging that a repository host is a national / international player providing a national / international service;
- establishing a potential host community network to encourage communication between them;
- ensuring that stakeholders are involved in decision making;
- recognising that ‘safety’ is always paramount;
- acknowledging the paradigm “no waste without energy - no energy without waste”;
- acknowledge that there could be trading arrangements on energy and waste between parties.

Two possible formats of regional solutions were identified by the group:

**Case 1:** • where small programmes utilise proposed facilities within major programmes;

**Case 2:** • where a group of interested countries form an ‘alliance’,

- for which the ‘entry’ requirement is that each country is a potential host, or
- where one country is identified as the preferred host.

#### **4.2.2 SWOT Analyses**

The end-points from the above brainstorming session selected for a SWOT analysis by the group included:

- introduction of a new EC Directive on radioactive waste management;
- small programmes utilise facilities in large programmes;
- form alliance of WMOs to search for one site;
- each member as per Case 2 is a potential host; and
- one country as per Case 2 is a preferred host.

The following tables reproduce the SWOT analyses as developed during the sessions.

<b>Introduction of a new EC Directive on radioactive waste management</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Makes the requirement to establish a solution mandatory</li> <li>• Provides a level playing field for all countries</li> <li>• Sends clear signals to all countries</li> <li>• Overcomes ‘wait and see’ approach by a country</li> <li>• There is predictability of obligations</li> <li>• Strengthens legitimacy of WMO actions towards nuclear communities and politicians</li> </ul>	<ul style="list-style-type: none"> <li>• May result in lowest common denominator being established</li> <li>• May be in conflict with national legislation or policies</li> <li>• There may be a long lead time for a Directive</li> <li>• Could have a ‘chicken-and-egg’ problem as the Directive is aimed at achieving political buy-in, but one needs such buy-in before one can establish the objective</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Tailor-made process for the achievement of the solution</li> <li>• Establishes a stepwise process</li> <li>• Transfers some of the politically difficult decision making burden from national politicians to the EC</li> <li>• Lays out clear recognition of social process costs</li> <li>• Takes account of the future generation burden</li> <li>• Can help set quality standards</li> </ul>	<ul style="list-style-type: none"> <li>• May be perceived as too aggressive (as before)</li> <li>• It may upset existing processes in a country</li> <li>• May be too prescriptive, not allowing flexibility</li> <li>• May result in lowest common denominator being established</li> </ul>

**Conclusions:** If designed carefully so as not de-rail processes in those MSs that are firmly en route to implementation, a new Directive can work towards increased acceptance among stakeholders of geological disposal as the preferred end-point for nuclear waste. The previous ‘Nuclear Package’ of Directives is judged to have failed to achieve sufficiently wide acceptance mainly because of the reactor safety and ‘non-nuclear’ radioactive waste aspects included. In the waste management area, a major stumbling block was that one MS, the UK, could not at that time agree to promote geological disposal. This obstacle has been removed by recent UK developments so that the chances of a new Directive being accepted may be higher.

<b>Small programmes utilise facilities in large programmes</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Benefits from economy of scale</li> <li>• Minimises environmental impact</li> <li>• Security centralised and easier vigilance</li> <li>• May benefit social acceptance in larger programmes</li> <li>• Good for nuclear energy in small countries</li> </ul>	<ul style="list-style-type: none"> <li>• Monopolisation of waste management by host</li> <li>• Encourages ‘wait-and-see’ approach in small programmes</li> <li>• ‘All eggs in one basket’, no other options</li> <li>• There could be a mismatch of timescales between countries</li> <li>• Could mean dependency on single supplier for disposal services</li> <li>• Forecloses other options</li> <li>• Displaces the social problem from one country to another</li> <li>• Increased transport risk</li> <li>• Language barriers</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Economic advantages for the host</li> <li>• ‘Monopoly rent’</li> <li>• Business opportunity for host</li> <li>• Reduced storage needs and costs</li> </ul>	<ul style="list-style-type: none"> <li>• ‘Monopoly rent’</li> <li>• Could be perceived as de-stabilising;</li> <li>• ‘Cognitive distance’ to a distant site (mistrust/public knowledge issues)</li> <li>• May encourage ‘out-of-sight/out-of-mind’ attitude towards the problem</li> <li>• Transit country risk.</li> </ul>

**Conclusions:** While there is the obvious advantage of economies of scale and the availability of know-how, the viability of this approach has to be carefully evaluated considering the design-for-needs and the public acceptance of the larger programmes. One problem is that some of the most advanced EU disposal programmes (e.g. Finland, Sweden and France) are still concerned that discussion on the possibility of small programmes being subsumed into large ones may derail their national repository plans. *Inter alia* for this reason these countries have introduced legislation or strict policies against import of wastes. The EC could help here by reiterating as strongly as possible that no MS can be compelled to accept foreign wastes against its will. At the same time, the EC could emphasize, as it has done in the past, that for large programmes where the option of import is not closed, there can be significant national economic benefits as well as European environmental advantages in such solutions.

<b>Formation of an alliance of WMOs to search for one site</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Larger engagement of stakeholders</li> <li>• Benefits from shared costs</li> <li>• Provides resilience to change</li> <li>• Lets national programmes 'off the hook'</li> <li>• Provides sense of equal partnership</li> <li>• Knowledge management is improved through shared resources</li> <li>• Organisation has 'strength' towards governments</li> </ul>	<ul style="list-style-type: none"> <li>• Can give rise to imbalance of power</li> <li>• Can encourage 'wait and see' stance</li> <li>• There are more national politicians to deal with</li> <li>• Complicated political/management structure</li> <li>• Timing mismatch</li> <li>• WMOs escape governance at national level</li> <li>• Financing complications</li> <li>• Language issues/barriers</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Cost benefits to host</li> <li>• More incentive to share information</li> <li>• Strength in numbers</li> <li>• Opens disposal route for countries that may not have one otherwise</li> <li>• Fosters creative thinking on solutions</li> <li>• Provides opportunity for earlier disposal</li> <li>• Provides opportunity for greater public acceptance.</li> </ul>	<ul style="list-style-type: none"> <li>• Conflict of interest with national WMOs</li> <li>• Displacement of burden onto vulnerable partner</li> <li>• Unfair burden on host country</li> <li>• No decision or fruitless discussions with stakeholders</li> <li>• Lack of commitment from a partner</li> <li>• Threat to existing national programmes</li> <li>• No host is found</li> <li>• Lack of political support</li> </ul>

**Conclusions:** As noted above, shared repositories are complex social and economic constructions. While there are obvious logistic, safety and safeguards benefits, the regulatory, liability and public acceptance issues have to be addressed first in a sustainable way. The formation of an alliance of several WMOs that have NOT definitively chosen the national repository approach may be more promising than the previous proposal that was subjected to a SWOT. It may be both prudent and more acceptable, if the WMOs involved treat the alliance as one branch of a dual track strategy that include also preparations for a national repository, if a regional solution does not emerge.

<b>Each member country of the alliance is a potential facility host and membership requirement is a qualified willingness to become a host</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Equitable partnership</li> <li>• Less opportunity for ‘wait-and-see’ attitudes</li> <li>• Each country is aware of respective responsibilities</li> <li>• Encourages stakeholder involvement</li> </ul>	<ul style="list-style-type: none"> <li>• Expensive site selection process</li> <li>• The decision-making process is more involved</li> <li>• Language barriers</li> <li>• Have to deal with national/cultural differences</li> <li>• Could give rise to more opposition</li> <li>• Would have to deal with ‘losers’, i.e. those not selected as host</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Encourages ‘competition’ attitude (rivalry)</li> <li>• Commercial opportunities</li> <li>• Regional development funding opportunities</li> <li>• Can help build community partnership through ‘criteria’ discussion</li> <li>• Local community gets more leverage</li> </ul>	<ul style="list-style-type: none"> <li>• Nobody joins</li> <li>• No agreement on site selection criteria</li> <li>• Withdrawal of member</li> <li>• Withdrawal of site</li> <li>• Threat to powers of local community</li> </ul>

**Conclusions:** While certainly justified from the point of view of equal distribution of burden, this approach has a high risk to founder on the NIMBY-syndrome and similar hidden agendas. With respect to repositories, the composition of the group, due to the available host formations, may also lead to an early prejudice for/against certain countries. An intermediate position may be more tenable, i.e. one in which each participant at the outset agrees evaluation of the pros and cons of their country being host. Factors looked at could cover geology, planning, transport, nuclear programme size etc. Important, however, is that the right of withdrawal should be clearly regulated. This is a situation that is directly parallel to national programmes that have a volunteering siting policy. In order to encourage as many as possible potential candidates to enter into the process, a clear right of withdrawal must be acknowledged during all the early stages of site selection. This approach has worked on a national scale in Sweden, for example, where the WMO announced clearly that it would withdraw from any community where public support was lacking.

<b>One member country of the alliance is identified up-front as facility host</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• ‘Cheaper’ site selection process</li> <li>• Could work well if there is a volunteer</li> <li>• Only a single concept need be developed</li> <li>• Fewer feasibility studies needed</li> <li>• Strong commitment by one party</li> <li>• Combined forces between members</li> </ul>	<ul style="list-style-type: none"> <li>• Unclear legal implications</li> <li>• More complex public acceptance issues</li> <li>• Need for harmonisation</li> <li>• Possibly unclear division of responsibility between partners (encourages ‘wait-and-see’ attitudes)</li> <li>• More politically unstable</li> <li>• Higher transport risks</li> <li>• Smaller knowledge base</li> <li>• Cross national quality management issues</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Business opportunity for host</li> <li>• Could move forward fast, if it receives public acceptance</li> <li>• Host community can name its price</li> </ul>	<ul style="list-style-type: none"> <li>• Host bails out</li> <li>• Host loses control</li> <li>• Encourages wait-and-see attitude among other partners</li> <li>• Externalisation of responsibilities</li> <li>• Bad faith</li> <li>• Monopoly</li> <li>• Commercial pressure outweighs safety and environmental concerns</li> </ul>

**Conclusions:** This is akin to the ‘shared repository’ case, but would encompass other types of facilities. For other types of facilities viable options might be developed, provided regulatory, liability and acceptance issues can be resolved. The early identification of a potential willing host could simplify development, reduce costs and greatly ease tensions in other countries. The SWOT comments, however, make clear that there are considerable political risks associated with this approach. In addition, of course, opportunities for optimising siting are reduced. In order to better track the development of national public opinion in this area, the EUROBAROMETER [5] could be amended in the future to re-introduce the relevant question in its scope.

## **4.3 Technological Aspects**

### **4.3.1 Summary of brainstorming discussion**

The group identified a number of topics that were categorised into the five broad topics below.

- 1) Harmonisation and standardisation
  - Create harmonised common technologies, e.g. standardised containers and waste emplacement,
  - Create three or four standardised repository designs,
  - Develop standardised approach to geological disposal safety case,
  - International qualification of transport systems,
  - Define minimum data requirements on wastes for purpose of geological disposal taking into account uncertainty about final solution.
- 2) Mechanisms for technology transfer
  - Each waste management organisation creates separate service provider,
  - Conduct study to develop fair charging scheme for transfer of technology and provision of services.
  - Develop realistic case study for CATT that could be proposed as a EU funded project
  - Make cost comparisons transparent but put costing on same basis as for energy futures.
- 3) Issues for shared repositories
  - Establish need for underground research laboratory (URL) for regional repository. The public is relatively positive towards a research facility. It is well known that it is very difficult to get acceptance for disposal of waste from other countries. The acceptance for a repository is much higher in communities where nuclear facilities already exist.
  - For shared facility: create a virtual system (and then work down). The design of a virtual system where a shared repository where all concrete topics are worked through would be a first step.
  - Establish a European Development Organisation (EDO) with emphasis on shared facilities. A regional repository where the participating countries shared the responsibility would require that some kind of legal entity is created.
  - Explore issues of phased disposal/retrievability in regional repository and demonstration of those.
- 4) Non-commercial training and dissemination
  - Develop use of specialised facilities (URLs) etc for education and training
  - New methods for communicating knowledge
  - Promote exchange of experts between programmes
  - Establish means of providing strategic peer reviews.
- 5) Other issues
  - Move away from policy of national responsibility for own waste
  - Do not treat SNF as a waste
  - Develop international repository in international waters

It is clear from the list above that technology, legal and socio-economic aspects are clearly linked. In particular the ‘Mechanisms for Technology Transfer’ could be viewed as more socio-economic.

### 4.3.2 SWOT Analyses

Based on these topics identified in the Brainstorming session the following five ‘Cases’ were singled out for the SWOT analysis.

- 1) Identify technology for disposal and/or encapsulation that is to be transferred and associated financing schemes;
- 2) Develop standardised approach to Geological Disposal designs, containers and safety cases;
- 3) Promote exchange of experts between programmes (with financial incentives);
- 4) Develop URL for regional repository as first step towards regional repository;
- 5) Define minimum data/requirements on wastes for purpose for shared repositories.

<b>Identify technology for disposal and/or encapsulation that is to be transferred and associated financing schemes</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"><li>• Planning Guide for new programmes (both technically and financially)</li><li>• Makes transparent what the technologies are.</li></ul>	<ul style="list-style-type: none"><li>• Technology is not the main problem</li><li>• Technology is host rock specific</li><li>• Needs acceptance requirement</li><li>• Constrains thinking (the best solution)</li><li>• Restricts commercial freedom of technology provider</li></ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"><li>• Mature Technologies are available such as KBS-3, NAGRA OPG, DBE salt</li><li>• Encourages thinking about what would be transferable</li></ul>	<ul style="list-style-type: none"><li>• Not suitable for (regional) conditions</li><li>• Diverts attention from conceptual thinking (and to ‘technologies’)</li></ul>

**Conclusions:** The group clearly see advantages with identifying specific technologies that can be more readily transferred and associated funding schemes. Some aspects are clearly more ‘transferable’ and it would be useful to identify these and how they can be transferred. There exist a number of advanced concepts that have been developed in the national programmes that could be used as a basis. This could clearly be used for speeding up the process in Member States that now are in an early stage. One should not expect any ‘off the shelf solutions’. A repository always needs to be tailored for the specific needs and environments and there is a risk that solutions transferred from another member state are not ideal for the specific situation. Issues involved with intellectual property transfer and with financial arrangements have been addressed in the CATT project, albeit without the emergence of any definitive proposals. This is a further issue that could be addressed in principle by an interdisciplinary group with legal and technical experts.



<b>Develop standardised approach to Geological Disposal designs, containers, and safety cases</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Makes technologies portable</li> <li>• Useful in the licensing phase</li> <li>• Increases general acceptability</li> <li>• Offers cost effectiveness</li> </ul>	<ul style="list-style-type: none"> <li>• Waste will not be the same in the future and standards may become obsolete</li> <li>• Difficult to get acceptance by individual programmes</li> <li>• Approaches are host-rock dependent</li> <li>• Reduces opportunities to optimize</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Intensifies co-operation</li> <li>• Encouragement to Regulators to standardize/harmonize</li> <li>• Opportunity to reduce errors from multiple users</li> </ul>	<ul style="list-style-type: none"> <li>• For some cases it may increase costs</li> <li>• For some cases could reduce safety</li> <li>• Common mode error</li> </ul>

### **Conclusions:**

This technological issue is strongly related to the first regulatory proposal for standardised pre-licensing of technologies. Standardised designs and concepts could make technology transfer easier, and it could also be very useful in licensing phase and also increase the acceptability by the public. Standardised designs could be a mean to harmonize regulations between Member States, which is often seen as an obstacle for technology transfer. There is, however, a risk that standardised solutions may not be the optimal solutions with respect to cost and safety for the different Member States' needs. Furthermore international standardisation is a slow process and there is a risk that standards are not based on the most recent scientific developments.

<b>Promote exchange of experts between programmes with financial incentives from for instance EC</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Efficient means of knowledge transfer</li> <li>• Enhance personal contacts</li> <li>• Develops 'new' experts</li> <li>• Affords on-the-job-training</li> <li>• Demonstrates commitment (e.g. of EC) to deliver</li> <li>• Provides access to required range of expertise</li> </ul>	<ul style="list-style-type: none"> <li>• It is being done already, so new initiatives open to challenge existing programmes</li> <li>• May be ineffective if programme is not sustainable</li> <li>• Programmes unwilling to release good people</li> <li>• Concern about undermining advanced programmes</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Use previous actions to improve exchange and exploit existing mechanisms</li> <li>• Optimize use of people across MS</li> <li>• Affords opportunity to transfer people with a lot of knowledge</li> <li>• Could provide peer review of the concept</li> <li>• New thinking</li> </ul>	<ul style="list-style-type: none"> <li>• Small programmes may have problems if their experts are absent temporarily</li> <li>• Seconded experts from small programmes may decide to stay with large programmes permanently</li> <li>• Cultural, linguistic and other incompatibilities</li> <li>• Could lead to sub-optimal use of expert (in response to financial inducements)</li> </ul>

**Conclusions:** For reasons listed in the S/O boxes, it would clearly be beneficial from an EU-wide perspective, if a system for exchange of experts were in place. There is a concern though that it could lead to drainage of experts from the small programmes. A well functioning exchange scheme requires that organisations are willing to release experts even if they are needed in their national programmes. The participants thought that it might be beneficial, if the EC could provide more financial assistance for such exchanges. Since many of the advanced national WMOs also run consulting wings, they may be more ready to attach personnel to developing programmes, if this can be done under a commercial arrangement. Given the common inequality in financial status between the advanced and developing programmes, this would certainly require EC financial input. A similar arrangement might also allow the EC to support the attachment of private consultants to help developing programmes.

<b>Develop URL for regional repository as first step towards regional repository</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• important towards siting</li> <li>• Intensify knowledge transfer</li> <li>• Promote regional repository concept from being only regional</li> <li>• Enhance public confidence/acceptance over URL operation period.</li> </ul>	<ul style="list-style-type: none"> <li>• Other facilities exist to provide opportunities for generic RTD</li> <li>• May site URL in location where repository is unsustainable and/or unacceptable</li> <li>• Needs financing</li> <li>• Needs promoter</li> <li>• Difficulty of finding host</li> <li>• Common problem with all geological disposal programmes that proof of safety may not be convincing</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Stepwise approach to regional repository</li> <li>• Gives flexibility to siting (if willing to develop multiple URLs)</li> <li>• Could convert URL into monitored pilot facility for demonstration</li> </ul>	<ul style="list-style-type: none"> <li>• Public/politicians do not like Trojan horses</li> <li>• May lead to evaluation that siting is not fair/legitimate</li> </ul>

**Conclusions:** A dedicated joint URL for countries that advocate regional repositories could be useful since it provides focal point for concrete collaboration, but without the controversy of a real repository. It would require the full commitment and support from all participating countries. However, the technical issues for a regional repository will not be very different from the questions that are being addressed already in national URL programmes and the added value of an additional URL may not be so strong. A URL in an ideal location could, in principle, be converted later to a repository but, if this is an option, it must be made clear at the outset, so that it is not seen by the public as non-transparent way to force a repository upon people.

<b>Define minimum data requirements on wastes for purpose for shared repositories</b>	
<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Provides standardised inventory data</li> <li>• Common/classification schemes</li> <li>• Clarifies waste management options for different wastes</li> </ul>	<ul style="list-style-type: none"> <li>• Compromised by commercial/confidential (e.g. military) processes</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Promotes transparency of waste inventory in MSs</li> <li>• Promotes waste acceptance criteria against range of final outcome</li> <li>• Guides waste conditioning</li> </ul>	<p><i>Note: not finalised due to time constraint</i></p>

**Conclusions:** This SWOT analysis was not finalised due to time constraint. Nevertheless, the group concluded that agreement on data/requirements on wastes would be very useful, and even necessary, for countries that would like to have shared facilities. The main problem is whether all countries would be willing to share this information on a more detailed level.

## 5. Conclusions and Perspectives

It had not been envisaged to develop specific recommendations or agendas for further work during this workshop. Rather, it had been intended to bring together different types of players in the field and facilitate the exchange of views so as to prepare the field for possible co-operations. In addition, the workshop participants, representing nuclear waste management organisations in Member States with varying levels of programme development, might give useful insights in their needs with respect to policy development.

### *Harmonised Regulations vs. Harmonised Standards and Criteria*

Harmonisation among Member States regulatory system, for instance at EU level, would in principle offer various benefits, including equal treatment throughout the European Union or increased public acceptance due to reassurance of adequate environmental and radiation protection. Given the varied state of development of the regulatory frameworks in MSs, it may be counterproductive to impose a common set of regulations. However, a common set of standards will facilitate international collaboration and trust by stakeholders.

Precondition for shared or joint facilities, including repositories, would be international agreements on short-term and long-term liabilities, waste ownership and the value of spent fuel. However, such agreements would certainly be difficult to bring about and to enforce effectively.

If designed carefully so as not de-rail processes in those Member States that are firmly en route to implementation, a new Directive can work towards increased acceptance among stakeholders of geological disposal as preferred end-point for residual nuclear waste.

### *The Benefits of Technology Transfer*

The workshop participants clearly see benefits in identifying specific radioactive waste management technologies that can be more or less readily transferred as well as the need to devise respective funding schemes. Some technology aspects are clearly more ‘transferable’ and it would be useful to identify these in detail and how they can be transferred. There exist a number of advanced technology transfer concepts that have been developed in the context of national programmes that could be used as a basis for further development. Such technology transfer schemes are likely to speed up the process of implementing final solutions for radioactive waste in Member States that now are only at an early stage of developing such solutions. However, one should not expect simple ‘off the shelf solutions’. In particular a repository always needs to be tailored for the specific needs and environments in a Member State. Otherwise there is a risk that solutions transferred from another Member State are not optimal for the specific situation.

### *Standardised Technical Solutions*

Standardised designs and concepts would facilitate technology transfer, could simplify the licensing phase and may also increase public trust. Standardised designs could be a means to harmonize regulations between Member States, the lack of which is often seen as an obstacle for technology transfer. There is, however, the risk that standardised solutions may not be the optimal solutions with respect to cost and safety for the different Member States’ needs. Furthermore international standardisation is a slow process and there is a risk that standards are based on less recent scientific developments than when drawn up nationally or are based on the lowest common denominator.

### ***Knowledge Management within the EU***

There is scope to further facilitate the exchange of experts at EU level. Given the small number of experts and little redundancy in functions, such exchange programmes might deprive national programmes of vital functions for some time. There is also the inherent risk that the trained expert does not return to the home country, finding conditions in the host country more attractive. In order to protect the interests and needs of small programmes, such exchange programmes need to be designed to emphasise the temporary nature of such placements.

URLs are becoming important focal points for knowledge exchange at EU and world level. There is already extensive collaboration and sharing of facilities using existing URLs in the context of the EU Framework Programmes. A dedicated joint URL for countries that advocate regional repositories would require the full commitment and support from all participating countries. However, the technical issues for a regional repository will not be very different from the issues in national programmes and the added value of an additional URL may not be very strong. A URL at a site suitable for a repository could be transformed into a repository, but may suffer from serious public acceptance issues as it could be viewed as a clandestine way to develop a repository.

Harmonisation of technical requirements, such as waste acceptance and other quality criteria, could pave the way for shared or joint solutions. This depends, however, on individual countries to share information and to subject their systems to harmonisation.

### ***Safeguards Issues***

Improved safeguards have been put forward as a possible driving force for shared or joint facilities. It should be noted, however, that the safeguards regime is too a large extent voluntary and, as recent examples have shown, only works as long as the signatory states are prepared to comply. Nevertheless, the transparency thus effected might work towards facilitating the implementation of waste management solutions.

### ***Shared vs. Joint Facilities Including Repositories***

Shared repositories are complex social and economic constructions. While there are obvious logistic, safety and safeguards benefits, the regulatory, liability and public acceptance issues have to be addressed in a sustainable way before one can commit a serious amount of resources to a project.

Projects may be designed on the basis of a number of notionally equal partners joining in, or on the basis that a junior partner, i.e. a smaller programme, is permitted to join a larger and more developed programme. There is the obvious advantage of economies of scale and the availability of know-how on the side of the senior partner, but the viability of this approach has to be carefully evaluated considering the design-for-needs and the public acceptance of the larger programmes.

The model whereby a group of Member States with smaller programmes seek a joint solution to be implemented on one of the partner's territories would be certainly justified from the point of view of equal distribution of burden. However, this approach risks foundering on the NIMBY-syndrome and similar hidden agendas, whereby participants try to off-load responsibilities onto other partners. With respect to repositories, the composition of the group, due to the available host formations, may also lead to an early prejudice for/against certain countries. If one partner is prepared up-front to host a facility or repository, has suitable conditions and can sufficiently assure the others of the capability to carry the project through, this model might be more viable.

### ***Institutionalised Collaboration***

There was a sense among participants that an institutional focal point might be helpful to bring about implementation, whether be it regional disposal solutions or shared management facilities. Such an organisation could be organised at European level and ensure that the momentum in any collaboration is maintained.

### ***Facilitating the Way Forward***

Considering the socio-economic and political circumstances in the European Union, it is clear that different Member States will (have to) pursue different options or combinations thereof. It is clear that some Member States will work towards purely national solutions and that some Member States do have the knowledge and man-power to do so. At the same time these Member States may have the capability to share their experience and perhaps even some facilities. On the other hand, there are likely certain benefits from shared solutions, be this waste treatment facilities or even repositories, with different types of collaboration models. For this reason it would appear to be reasonable to bring together all parties and to search for different solution models in parallel. It is likely that the various parties concerned would benefit from sharing knowledge and from the transfer of technology. With this background in mind, it would be reasonable to harness together activities such as CATT and SAPIERR, perhaps under the auspices of the EC, in order to arrive at integrated recommendations for the way forward in all Member States facing the need to find solutions for the final disposal of radioactive wastes.

## 6. References

- [1] JOINT CONVENTION ON THE SAFETY OF SPENT FUEL MANAGEMENT AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT, <http://www-ns.iaea.org/conventions/waste-jointconvention.htm>.
- [2] ARBEITSKREIS AUSWAHLVERFAHREN ENDLAGERSTANDORTE (2002): Auswahlverfahren für Endlagerstandorte - Empfehlung des AkEnd.- 47 p., [http://www.bmu.de/files/pdfs/allgemein/application/pdf/akend\\_bericht.pdf](http://www.bmu.de/files/pdfs/allgemein/application/pdf/akend_bericht.pdf)
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- [5] EUROBAROMETER, [http://ec.europa.eu/public\\_opinion/index\\_en.htm](http://ec.europa.eu/public_opinion/index_en.htm)



# Annex 1: Workshop Agenda

## Day 1

Time	Presentation	Organisation	Name
08:30 – 08:40	Welcome	DPRAO/JRC	N.N. / K.-F. Nilsson
08:40 – 08:50	Organisational matters	DPRAO	I. Stefanova
08:50 – 09:20	Opening presentation on international collaboration on long-term radioactive waste management	Arius	C. McCombie
Activities in the European Commission			
09:20 – 09:40	Technology transfer through joint R&TD	EC DG-RTD	G. Di Bartolo
09:40 – 10:00	Moving ahead: EC radioactive waste management policy	EC DG-TREN	W. Hilden
10:00 – 10:20	Coffee break		
10:20 – 10:50	SAPIERR-1 and 2	COVRA	E. Verhoef
10:50 – 11:20	CATT	NDA	J. Mathieson
Supporting International Activities			
11:20 – 11:40	Fostering information exchange in waste management and fuel repatriation	IAEA	B. Neerdael
11: 40 – 12:00	Facilitating implementation: The importance of stakeholder participation	Univ. of Versailles	M. O’Connor
12:00 – 13:30	Lunch		
International Projects on Implementation			
13:30 – 13:50	SKB/POSIVA: A working collaboration	POSIVA	J. Vira
13:50 – 14:10	Small programmes’ needs	ARAO	I. Mele
14:10 – 14:30	Big programmes’ offers and needs	NDA	A. Hooper
14:30 – 14:50	Model for sharing and transfer of knowledge in the field of radioactive waste management - both non-commercial and commercial	SKB	M. Hammarstöm
14: 50 – 15:00	Management of HLW and LILW-LL in Bulgaria	BNRA	R. Markova-Mihaylova
15: 00 – 15:40	Moderated discussion with the speakers	all	all
15:40 – 16:00	Coffee break		
Breakout Sessions			
16:00 – 18:00	<ul style="list-style-type: none"><li>• Legal/Regulatory aspects</li><li>• Socio-economic aspects</li><li>• Technological aspects</li></ul>	<ul style="list-style-type: none"><li>• N. Chapman/ I. Mele</li><li>• J. Mathieson/ A. Bergman</li><li>• A. Hooper/ K.-F. Nilsson</li></ul>	Participants circulate between the three groups (40 min/group)

## Day 2

Time	Presentation	Organisation	Name
<i>Breakout sessions continued</i>			
08:30– 10:30	<ul style="list-style-type: none"> <li>• Legal/Regulatory aspects</li> <li>• Socio-economic aspects</li> <li>• Technological aspects</li> </ul>	<ul style="list-style-type: none"> <li>• N. Chapman/ I. Mele</li> <li>• J. Mathieson/ A. Bergmans</li> <li>• A. Hooper/ K.-F. Nilsson</li> </ul>	Participants remain in one group
10:30 – 11:00	<i>Coffee break</i>		
<i>Plenary Session</i>			
11:00 – 12:00	Presentations by Breakout Session group findings	<ul style="list-style-type: none"> <li>• N. Chapman/ I. Mele</li> <li>• J. Mathieson/ A. Bergmans</li> <li>• A. Hooper/ K.-F. Nilsson</li> </ul>	
12:00 – 13:00	Conclusions		<i>All</i>
<i>Adjourn</i>			
13:00 – 14:00	<i>Lunch</i>		

## Annex 2: List of Participants

<b>Name</b>	<b>Organization and Country</b>
Barescut, Jean-Claude	IRSN, France
Bergmans, Anne	Univ. of Antwerpen, Belgium
Boyanov, S.	DPRAO, Bulgaria
Chapman, Neil	ARIUS Associated, Switzerland
Crossland, Ian	Crossland Consulting, UK
Di Bartolo, Gaetano	European Commission, DG-RTD
Dreimanis, Andrejs	Radiation Safety Centre, Latvia
Falck, W.Eberhard	European Commission, DG-JRC
Hammarström, Monika	SKB, Sweden
Haverkamp, Bernt	DBE Technology, Germany
Hilden, Wolfgang	European Commission, DG-TREN
Günter Hillebrand	Nuclear Engineering, Austria
Hooper, Alan	Alan Hooper Consulting, UK
Karakelle, Bektas	Turkish Atomic Energy Agency, Turkey
Kawamura, Hideki	Obayashi Corporation, Japan
Lambev, N.	DPRAO, Bulgaria
Lijescu, Cristian	ANDRAD, Romania
Markova-Mihaylova, Radosveta	Nuclear Regulatory Agency, Bulgaria
Martin, Simon	Sellafield Limited, UK
Mathieson, John	NDA, UK
McCombie, Charles	ARIUS Associated, Switzerland
Mele, Irena	ARAO, Slovenia
Motiejunas, Stasys	RATA, Lithuania
Neerdael, Bernard	IAEA
Negut, Georghe	ANDRAD, Romania
Nilsson, Karl-Fredrik	European Commission, DG-JRC
O'Connor, Martin	University of Versailles, France
Ormai, Peter	PURAM, Hungary
Radu, Maria	CITON, Romania
Rybalchenko, Igor	VNIPIET Institute, Russia
Salzer, Peter	DECOM, Slovakia
Stefanova, Ira	DPRAO, Bulgaria
Sumberova, Vera	RWRA, Czech Republic
Verhoef, Ewoud	COVRA, The Netherlands
Vira, Juhani	Posiva, Finland

## Annex 3: Presentations

### A3-1. Presentation CHARLES McCOMBIE (ARIUS, Switzerland)

# International Collaboration on Long-Term Waste Management

Charles McCombie  
Arius Association  
Switzerland

Workshop on  
European Collaboration for the Management of Spent Nuclear Fuel  
and Radioactive Waste by Technology Transfer and Shared Facilities  
Sofia, Bulgaria,



## Key cooperation areas

- Developing strategies and concepts
- Knowledge exchange
- Developing methodologies
- Producing experimental results
- Organising joint research projects
- Provision of services
- Communication activities
- Implementing waste management facilities




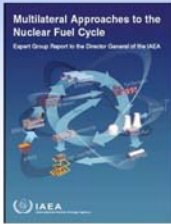
## Developing strategies and concepts

- Principle of deep geological disposal
- Multi-barrier concept
- Variety of host-rocks and materials
- Siting approaches
- Staged repository development
- Enhancing security ➡ **EFFORTS IN THIS AREA MUST BE INTENSIFIED!**




## Strengthening the Nuclear Non-Proliferation Regime

*It is important to tighten control ... which could be done ... under some form of multilateral control, in a limited number of regional centers....."*

Multilateral Approaches to the Nuclear Fuel Cycle  
Expert Group Report to the Director General of the IAEA




## Knowledge Exchange

- Open publications, incl. reports
- Bilateral agreements
- International organisations (IAEA, EC, WNA etc.)
- Conferences, workshops
- Personnel exchange
- International Advisory Groups
- Dedicated courses (IAEA, ITC, etc.)



## Developing methodologies

- Experimental
  - Lab measurements
    - leaching, sorption, diffusion, etc.
  - Field testing
    - seismic, drilling, hydrology, core mapping, etc.
  - Underground Labs
    - construction methods, in-situ migration, geophysics
- Theoretical
  - Safety Assessment
    - hydrogeology, geochemistry, transport, biosphere, scenario analysis, etc.
  - Safety Case approach
    - STILL DEVELOPING



## Organising joint research projects

- ➔ Internationally coordinated, e.g.
  - EC: Framework Programmes
  - IAEA: Coordinated Research Programmes
- ➔ Numerous ad-hoc, e.g.
  - Swedish-American SAC - URL
  - JSS – waste form
  - Pocos de Caldas – analogues
  - Intracoin family – safety assessment

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## Provision of Services

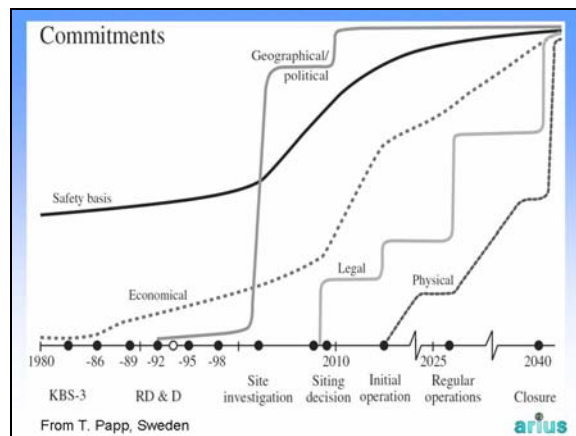
- ➔ Consulting activities
  - Advisory and review roles
  - Lab measurements
  - Field investigations
- ➔ Reprocessing; waste conditioning
- ➔ Implementation of Stores
- ➔ (Limited) transfer of wastes

arius

## Communication activities

- ➔ Shared documentation
- ➔ Joint projects (e.g. analogue film)
- ➔ Provision of foreign speakers
- ➔ Visits to foreign facilities
- ➔ Joint governance projects (e.g. EC FP6, NEA FSC)

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## Cooperation on WM facilities

- ➔ Design & construction of interim stores
- ➔ Design & construction of LLW repositories
- ➔ Design of reprocessing/vitrification plants
- ➔ Operation of underground laboratories
- ➔ Design of deep repositories
- ➔ No shared encapsulation or repositories (yet!)

arius

## Key cooperation areas

- ➔ Developing strategies and concepts
  - ➔ Knowledge exchange
  - ➔ Developing methodologies
  - ➔ Producing experimental results
  - ➔ Organising joint research projects
  - ➔ Provision of services
  - ➔ Communication activities
  - ➔ Implementing waste management facilities
- A continuous spectrum of possibilities

arius

## Potential drawbacks of international collaboration??

- ➔ Competition for national researchers!
- ➔ Less political/financial support for national programmes
- ➔ "One size fits all" mentality – not all concepts, processes and costs are transferable
- ➔ Limited freedom of thought – less "outside the box" thinking
- ➔ Truly independent review of national programmes

arius

## Conclusions to date

- ➔ Non-commercial approaches helped early cooperation
- ➔ A large body of shared results and knowledge exists
- ➔ Nevertheless, there has been (and is) significant duplication between national programmes and also international organisations
- ➔ "Nuclear renaissance" has intensified need for knowledge transfer and cooperation in WM
- ➔ We need to do MORE - future directions ?

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## Future directions

- Greater regulatory harmonisation
- Increased Education and Training
- Technology transfer
- Provision of commercial services
- Standardised technologies
- Shared WM facilities
  - Conditioning
  - Encapsulation plants
  - Repositories



## The Sofia Workshop

- Originally: CATT-SAPIERR Workshop
- SAPIERR: goal = shared regional storage and disposal facilities for those countries that wish to cooperate
- CATT: goal = technology transfer on order to enable national solutions to disposal
- EC insight: these are part of a continuous spectrum of cooperation possibilities for European countries – with a common goal.....



## A Common Goal

- *To ensure that all European countries have access to safe and secure geological repositories on appropriate timescales*
- Constraints:
  - State-of-the art technology
  - Affordable disposal
  - An implementation process that is “fair” for all
  - No pseudo-ethical assertions on waste transfers
    - No country can be compelled to accept foreign waste
    - Any country can choose to accept foreign waste



## Actions not Words!

- Lots of cooperation initiatives have been and are being carried out (cf other talks)
- What can we do in Sofia?
  - Brainstorm on what else can be done – specific proposals for actions
  - Technical; regulatory; societal
  - Analyse the strengths, weaknesses, opportunities and threats that the proposals create!
  - Agree on the most constructive way forward – in general and also in the scope of FP7



## The End





## A3-2. Presentation GIOVANNI DI BARTOLO (EC, DG-RTD)

 **Technology Transfer**  
in EC funded R&D on Geological Disposal

Workshop on European Collaboration for Implementation of Long-Term Management Solutions for Spent Nuclear Fuel and Radioactive waste  
Sofia, dec. 10-11, 2007

 **ToGEThe®**  
SINCE 1957

*Euratom treaty: 50<sup>th</sup> Anniversary in 2007*

DG RTD (Research and Tech. Develop.)  
Unit J2 – Nuclear Fission & RP  
Gaetano DI BARTOLO

10-11/12/2007

 **Overview**


- **Technology transfer**
  - Generalities
  - Degrees of transfer and integration
- **Geological Disposal Technology Platform**

10-11/12/2007

 **Technology transfer: generalities**

- Technology transfer classically has been associated with the diffusion of technologies and processes **across national boundaries**. But in recent years, the term has been attached with equal significance to the flow of ideas and knowledge within and between organizations within the **same economy or nation**.
- When the organizations involved are business corporations and government agencies, the term **knowledge management** often is used as a synonym for act of transfer or diffusion.
- **Knowledge management in and between member states contributes to the goal of making Europe the most competitive and dynamic knowledge based economy in the world (Lisbon Strategy)**

10-11/12/2007


 **In FP7 Euratom "Fission programme" in general and Geological Disposal**

**Knowledge transfer is embedded in the Objectives**

- "Promote safer, **more resource-efficient** and competitive exploitation of nuclear energy"
- "to underpin the development of a **common European view** on the main issues"

**Knowledge transfer is explicitly foreseen in the training and dissemination activities.**

10-11/12/2007

 **Knowledge management in GD**

**1st degree of transfer and integration (CATT)**

- **Protection of intellectual property rights and cross-border licensing of technologies.**
- **Transfer of liabilities (malfunctioning of transferred technologies or supplied components)**
- **Harmonisation of regulations.**

**2nd degree of transfer and integration (CATT + SAPIERRE)**

- Technology transfer + Shared repositories

**Management of the degrees of transfer and integration**

- A Technology Platform on GD could be a better instrument of coordination

10-11/12/2007

 **Technology Platforms: generalities**

- The TPs belong to their stakeholders – not to the EC. The EC supports the creation and operation of the TPs when it fits with the objectives and policies of the EU.
- **Stakeholders** (eg a High Level Group of personalities), usually led by industry, come together to agree a **common Vision** for the technology
- **Stakeholders** define a **Strategic Research Agenda** setting out medium and long term objectives for the technology - **Stakeholders** develop a **Deployment Strategy** (means to implement the SRA)
- **Stakeholders** implement the Strategic Research Agenda with the mobilisation of significant human and financial resources
- **TP Structure/organisation:** Forum of Stakeholders or General Assembly, Advisory or Steering Group, Exec Group, Secretariat, Working groups (SRA, Education & Trg, Research Infra, Dissemination, Governance,...)

10-11/12/2007


 Like the **"Sustainable Nuclear Energy TP"(SNE-TP)**, whose goal is to enhance EU's technological leadership in nuclear science and technology, the

**GD Technology Platform**

would bring together all key Stakeholders, (Research Organizations, Regulators, TSO Technical Support Organizations), driven by Waste Management Organizations (WMO), to carry out "implementation oriented" activities, with the **largest possible degree of transfer and integration.**

10-11/12/2007


 COMMUNITY POLICY & RESEARCH AND TRAINING ACTIVITIES

**EURADWASTE '08**

20-23 October 2008  
 Luxembourg

[www.cordis.europa.eu/fp7/euratom-fission/events\\_en.html](http://www.cordis.europa.eu/fp7/euratom-fission/events_en.html)

**OBJECTIVES and SCOPE:**

- Present an overview of all recent **European Commission** (EC) activities in radioactive waste management (R&D, policy, strategic and socio-political aspects). Present Euratom FP6 project results in geological disposal and partitioning & transmutation.

**THEMES:**

- Community Policy (management of radioactive waste, research policy, future strategies)
- Socio-political aspects (governance and decision-making, public perception and acceptance, stakeholder involvement, sustainability issues)
- FP6 research programme (repository near-field processes, Engineered Barrier Systems; radionuclide migration in the far-field; engineering studies and repository technologies; Performance Assessment; co-operation, technology transfer and developments of options for shared repositories; co-ordination of national research programmes; status in P&T techniques and technologies)

**VENUE:** EC conference centre, Luxembourg

**PROGRAMME:** Technical sessions 3 days (20-22 Oct. 2008), URL technical visits: Bure, FR and HADES Mol, BE (23 Oct. 2008)

Further information and PRE-REGISTRATION on line



### A3-3. Presentation WOLFGANG HILDEN (EC, DG-TREN)



**EC RADIOACTIVE WASTE MANAGEMENT POLICY**

CATT Workshop,  
Sofia, 10-11 Dec 2007

DG Transport and Energy  
Wolfgang Hilden  
10/12/2007



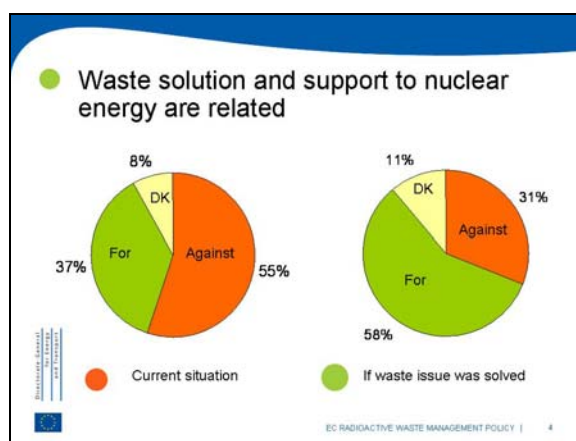
Take-off ...  
... but no runway to land on...

The nuclear waste saga



Expectations and believes of EU citizens

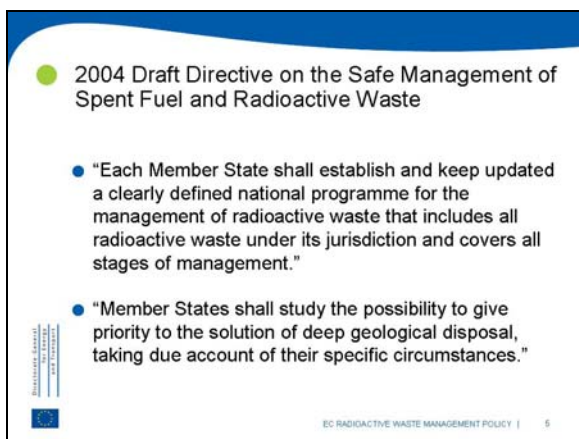
- 92% - Develop solutions now  
91% - High time for MS to set deadlines
- 81% - Decisions are politically unpopular
- 79% - No safe solution yet!



Waste solution and support to nuclear energy are related

Current situation: 37% For, 55% Against, 8% DK

If waste issue was solved: 58% For, 31% Against, 11% DK



2004 Draft Directive on the Safe Management of Spent Fuel and Radioactive Waste

- "Each Member State shall establish and keep updated a clearly defined national programme for the management of radioactive waste that includes all radioactive waste under its jurisdiction and covers all stages of management."
- "Member States shall study the possibility to give priority to the solution of deep geological disposal, taking due account of their specific circumstances."



Council-Conclusions 8 May 2007

- Develop strategies for the safe management of all types of spent fuel and radioactive waste.
- Urge each EU Member State to establish and keep updated a national programme for the safe management of radioactive waste and spent fuel...
- ... that includes all radioactive waste under its jurisdiction and covers all stages of management.
- ... supports the establishment of a High Level Group at EU-level aimed at furthering a common approach

## Commissioner A. Piebalgs EP Hearing 3 July 2007

- Research FP: ~ 200M€ alone since 1994
- Sufficiently demonstrated that geological disposal represents the safest and most sustainable option for the LT management of HLW.
- It is now time for the Member States to implement disposal solutions for high level waste without further delay.



## Commissioner A. Piebalgs EP Hearing 3 July 2007 (cont.)

- Proposals from non-EU states for disposal of waste and spent fuel should not be encouraged for technical, economical and also safety and security reasons.
- In particular true when the potential receiving state has not put in place the same technical, political and societal requirements and conditions as given at EU level.



## Commissioner A. Piebalgs EP Hearing 3 July 2007 (cont.)

- Finland: demonstrates that even countries with small programmes can afford its own national repository...
- ...if research is shared with others to minimise cost (e.g. Aspö).



## Commissioner A. Piebalgs EP Hearing 3 July 2007 (cont.)

- The regional solution is appealing it in terms of economy of scale... (but) ...a country must be willing to host such a regional centre
- In no way should the hope for regional solutions be used as argument for a wait-and-see policy.
- Instead, each MS should actively seek for solutions on its own territory



## Commissioner A. Piebalgs EP Hearing 3 July 2007 (cont.)

- Implementation of deep geological disposal is an essential condition for the continued use and potential expansion of nuclear power.
- All initiatives leading to encouraging and facilitating progress towards identification and operation of waste repositories are therefore highly welcome
- CATT and joint use of URLs - important to avoid reinventing the wheel



## Some people regard "wait-and-see" as good policy...

- Deep geological repository Finland:
  - 1978: Start feasibility studies
  - 1983: Government decision on objectives
  - 2001: Decision in principle
  - 2012: Application for construction
  - 2018: Application for operation
  - 2020: Start of disposal
- 40 years.... (when things are running smoothly)
- Start now – do not follow a "mañana" policy
- You dream of regional repositories?  
Start from the assumption it will be in your country!



Thank you for your attention!



- If you fail to plan, you plan to fail.

### A3-4. Presentation EWOUT VERHOEF (COVRA, The Netherlands)

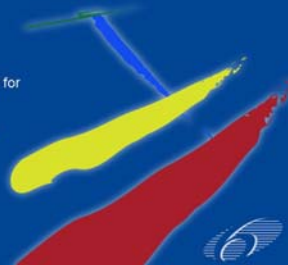
## SAPIERR II

European concepts for shared storage and disposal facilities for radioactive waste?

Ewoud Verhoef


Workshop on European Collaboration for Implementation of Long-Term Management Solutions for Spent Nuclear Fuel and Radioactive Waste

December 10-11 2007 in Park Hotel Vitosha, Sofia, Bulgaria



## Content

- Background
- SAPIERR I
- SAPIERR II
- Some results
- Outlook



## Geological disposal

In some countries it is difficult or impossible to develop national solutions for the radioactive waste:

- financial and technical resources,
- research capacity,
- suitable geological formations

Others are interested in economic optimisation:

- economies of scale
- more productive uses for public funds




## CATT and SAPIERR

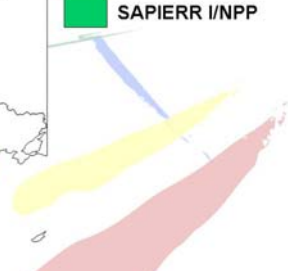
- CATT:
  - Co-operation And Technology Transfer on long-term radioactive waste management for Member States with small nuclear programmes 2006-2007
- SAPIERR I:
  - Support Action on a Pilot Initiative for European Regional Repositories 2003-2005
- SAPIERR II:
  - Strategic Action Plan for Implementation of European Regional Repositories 2006-2008



## SAPIERR I




- SAPIERR I
- SAPIERR I/NPP



## SAPIERR I Options

- 1 repository for all spent fuel and HLW
- 1 repository for all spent fuel, HLW and long-lived ILW
- 2 different repositories for spent fuel and for HLW
- 1 repository for all spent fuel and HLW and 1 repository for long-lived ILW





## SAPIERR I Concepts

- **Well developed concepts:**
  - Granite (KBS-3H/NAGRA) & clay (NAGRA)
  - Most important directions in European geological disposal programmes
- **Horizontal disposition**
  - Chosen because of length of spent fuel elements (4.6 m)

## SAPIERR I Conclusions

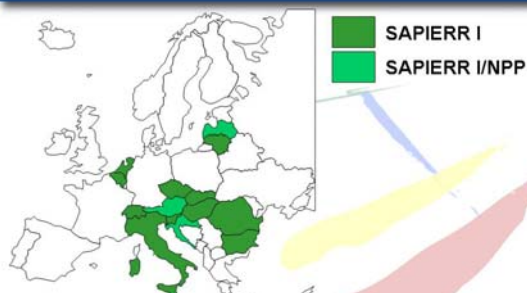
- Potential advantages widely acknowledged in the EU
- Clearest advantages in the field of economy
- Most of the problems comparable with that of national programmes (in particular siting)
- Increased efforts needed now
- For further work a structured framework must be established

## SAPIERR I Conclusions

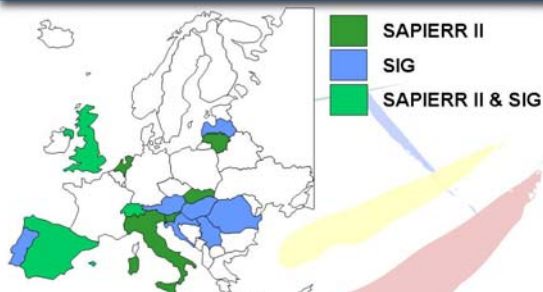
- 2035 target repository operational date (2030 for encapsulation plant)
- 20 – 25 years typical siting, SI work
- 2010 – 2015 start the process
- So, start **NOW** on assessing how to set legal and organisational structures in place:

SAPIERR II

## SAPIERR I



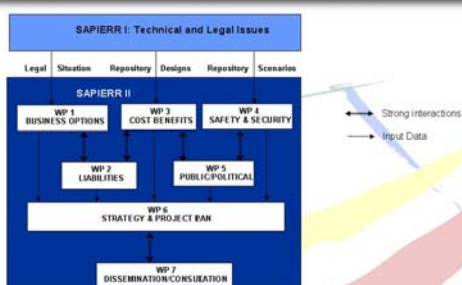
## SAPIERR II



## SAPIERR II Objectives

- Define options for organisational frameworks and project plans for a modestly sized, self-sufficient European Development Organisation (EDO)
- Clarify legal, economic, safety and security, and societal aspects of shared regional solutions
- Present the results and recommendations at a workshop for interested countries

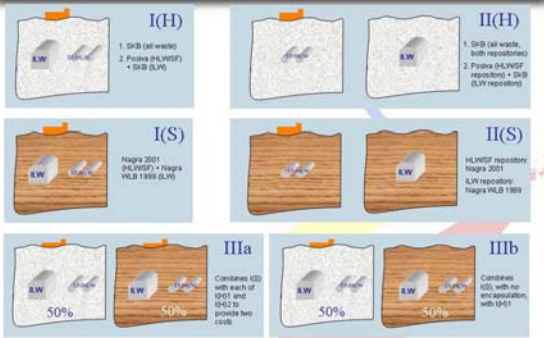
## SAPIERR II



## Who is doing what

WP1	Legal & Business Options for EDO	ENEA
WP2	Legal Liability Issues	DECOM
WP3	Economic Issues	Arius
WP4	Safety & Security Implications	SAM
WP5	Public & Political Attitudes	Enviros
WP6	Strategy and Project Plan for the EDO	Arius
WP7	Project Management & Info Dissemination	COVRA/Arius

## SAPIERR II Scenarios



## SAPIERR II – WP5

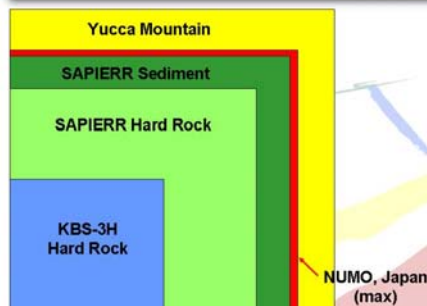
### • WP5: drawbacks and advantages for local communities

- **Advantages**
  1. Enhancement of economy/compensation
  2. High-tech employment opportunities/improvement infrastructure
- **Disadvantages**
  1. Reputation as a tourist or agricultural region
  2. Perception of safety
  3. Property value

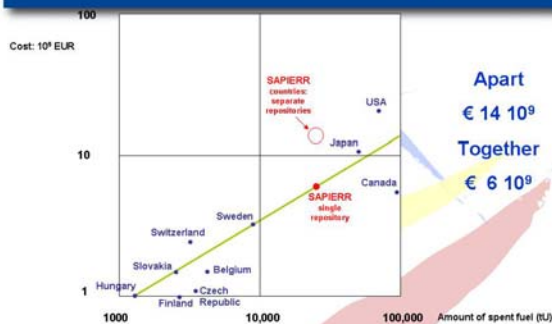
## SAPIERR I Inventory

- **13.246 spent fuel containers**
  - Swiss (Nagra) steel container (6061 of 5,0 m length, 2341 of 4,3 m length and 4844 of 3,7 m length)
- **2.021 HLW containers**
  - With a length of 2,0 m (steel container ~COGEMA BNFL)
- **31,000 m<sup>3</sup> LL-LW**
- **NB: this is a relatively large repository**
  - Compare Sweden: ~6000 containers;
  - Finland ~2500 containers

## SAPIERR I Relative sizes



## SAPIERR I Economy



## SAPIERR II - WP1

- **Draft report**
  - **EDO: Goals, activities and internal structures discussed**
  - **EDO/ERO: Organisation Form – options**
    - Association
    - Cooperative ★★
    - European Economic Interest Group
    - Intergovernmental organisation (IGO) ★
    - Joint Technological Initiative (JTI)
    - Consortium ★★
    - Joint venture
    - Corporation or shareholding company

## SAPIERR II – WP2

- **Draft report**
  - **EDO/ERO: Responsibilities and liabilities defined**
  - **Comparison with national constraints**
  - **Key issues:**
    - Transfer of title
    - Regulatory interactions
    - Retrievability

## Results SAPIERR II

- **WP3**
  - **Cost estimates for:**
    - Transport
    - Storage
    - Disposal
  - **Benefits packages**
    - Review of national cases
    - SWOT on potential multinational approaches

## SAPIERR II – WP5

- **Questionnaire to mayors**
  - 2 workshops of EC funded European Project Local Competence Building and Public Information in European Nuclear Territories:
    - Germany, September 2007
    - Brussels, October 2007
  - 45 local representatives from different municipalities of six European countries

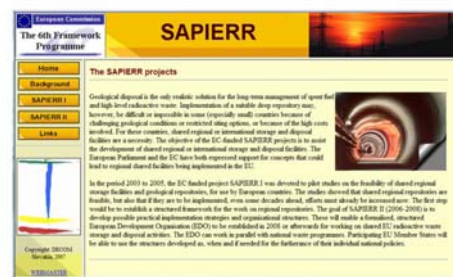
## SAPIERR II – WP5

- **Support to a European organization?**
  - Possible collaboration among EU countries to develop shared repositories
    - 55% agree
    - 23% require further investigation and debate
    - 11% do not know or do not answer
    - only 11% do not agree
  - Initiative to further investigate the possibility of setting up a shared repository
    - 73% would support
    - 11% would not support such an initiative

## SAPIERR II – WP5

- **Siting a shared repository**
  - Procedure
    - ++ Local community volunteering
    - + National agreement
    - EU decision/majority decision by participant countries
  - Important issues
    - ++ Safety
    - + Trust in implementing organization/type rad. waste/economic compensation
    - number of exporting EU countries/ cost operational phase/volume of waste

## SAPIERR II Outlook



[www.SAPIERR.net](http://www.SAPIERR.net)

## SAPIERR II – WP7

- **Dissemination**
  - Reports at conferences (ICEM, Reposafe)
  - Internet site & Newsletter(s)
  - Discussions with IAEA on transferability of SAPIERR regional approach to other regions of the world

## SAPIERR II Outlook

- **CATT - SAPIERR workshop**
  - Sofia, Bulgaria
- **Key outstanding activities**
  - Reviews of draft WP reports
  - Bilateral discussions
  - Final workshop
  - Joint meeting of potential EDO participants
- **Potential outcomes:**
  1. Establish EDO
  2. Further studies required
  3. At this moment, further efforts not productive

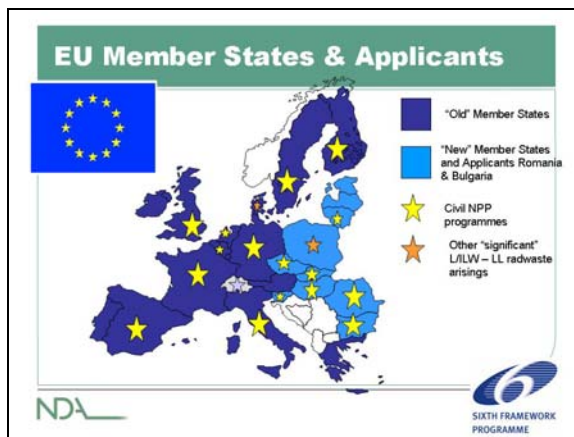


## A3-5. Presentation JOHN MATHIESON (NDA, UK)

**NDA**  
Nuclear  
Decommissioning  
Authority

**"CATT"**  
**A project on Co-operation and  
Technology Transfer on Long-Term  
Radioactive Waste Management for EU  
Member States with Small Nuclear  
Programmes**

Presentation to CATT-SAPIERR Workshop,  
Sofia, 10-11 December, 2007  
John Mathieson, NDA (UK)



**Issues for small countries?**

- Some countries unable to develop own radioactive waste management solutions
  - insufficient financial, human, technical resources
- Larger waste management programmes have invested €/bn in technologies for
  - site characterisation
  - encapsulation
  - disposal concepts

**NDA**  
SIXTH FRAMEWORK  
PROGRAMME

**Encapsulation & Disposal Concepts**

**NDA**  
SIXTH FRAMEWORK  
PROGRAMME

**Solution for small countries?**

- Import the technology
  - HLW/SF technologies
  - encapsulation, transport, disposal concepts
  - financial assistance if needs be
- Don't export the waste
  - radioactive waste is an emotive subject
  - somebody else's even more so
  - controversial especially with potential host communities

**NDA**  
SIXTH FRAMEWORK  
PROGRAMME

**CATT – EU FP6 Project**

- CATT
  - Co-operation and technology transfer on long-term radioactive waste management for Member States with small nuclear programmes
- Partner Waste Management Organisations:
  - Bulgaria (DPRAO), Germany (DBE TEC), Lithuania (RATA), Slovenia (ARAO), Sweden (SKB IC), UK (Nirex/NDA); + EU's Joint Research Centre (Netherlands)
- 18 month feasibility project
  - January 2006 – June 2007

**NDA**  
SIXTH FRAMEWORK  
PROGRAMME

## CATT objectives

- Explore viability of TT between large & small programmes
- Analyse RWM steps & recommend TT solutions
- Develop collaboration "models" between countries
- Propose future demonstration project in EU

NDAL



## TT feasibility issues (1)

- Government policies
  - schemes will require Government approval
- Legal
  - transboundary movement
  - nuclear liability
- Commercial
  - intellectual property
    - financial return for Technology Owners

NDAL



## TT feasibility issues (2)

- Encapsulations scenarios
  - regional
  - country specific
  - existing
- Siting of new facilities
  - "siteability",
  - geology, demography,
  - public attitudes, etc.

NDAL



## TT feasibility issues (3)

- Transport safety
  - no new issues, SF already transported
- Financial resourcing
  - additional funds, grants
- Human resources
  - regional pool

NDAL



## Benefits of TT schemes

- Financial:
  - Exploitation of IP gives financial return
  - Cost-effective solutions for TT recipients
  - EU will benefit – return on previous R&D investments
- Social
  - Member States remain responsible for their own waste within their own borders
  - Less controversial than Regional Repository solution
  - Creation of highly skilled pool of expertise

NDAL



## CATT Programme (1)

- WP1- Information Gathering (5m)
  - Potential "Technology Owner Member States"
    - Belgium, France, Germany, Netherlands, Spain, Sweden, UK
  - Potential "Technology Acquiring Member States"
    - Bulgaria, Czech Republic, Hungary, Lithuania, Romania, Slovak Republic, Slovenia
  - Recognise MS could be either (e.g. UK)
- WP2 - Website and Web-based information system (18m)
  - [www.catt.jrc.nl](http://www.catt.jrc.nl)

NDAL



## CATT Programme (2)

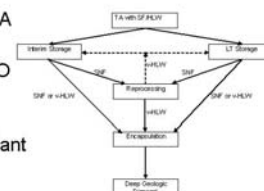
- WP3 – Information analysis & Workshop (6m)
  - TT Capabilities & requirements
  - Scenario studies
  - HR requirements
  - Legal & Commercial Analysis
  - Review by workshop
- WP4 – Develop Collaboration Models & Workshop (4m)
  - Implementability of each scenario, collaboration model
  - Financial, legal, commercial, logistics, HR aspects
  - Review by workshop
- WP5 - Practical Application (1m)
  - Demonstration project for FP7?

NDAL



## Scenarios

- National EP in TA Country
- Existing EP in TO Country
- New EP at Reprocessing Plant
- Shared EP



NDAL





## FP7 – Pilot implementation?

- Identified country specific collaboration scenarios
- Explore requirements
  - costs
  - schedule
  - changes to law
  - transport requirements
  - regulatory requirements
  - specific design requirements
  - training
  - funding
- Ministerial – Regulatory approval?




## A3-6. Presentation BERNARD NEERDAEL (IAEA, NEFW/WTs)

**Fostering information exchange in waste management and fuel repatriation**

Bernard NEERDAEL  
IAEA/NE/NEFW/WTs

Workshop on European collaboration for implementation of long-term management solutions for SNF and RW  
Sofia  
December 10-11, 2007



IAEA  
International Atomic Energy Agency

**Frame**


NE Department

Division of Nuclear Fuel Cycle and Waste Technology

For waste management: **Waste Technology Section**  
Waste Predisposal Management Unit  
Waste Disposal Unit (\*)

(\*) Main programme:  
L2.04 - Building confidence and transferring technologies for the disposal of RW


For fuel repatriation: **Nuclear Fuel Cycle and Material section**  
SNF Management Technology Unit  
Research Reactor fuel cycle Unit



IAEA

**WM/D - A few ongoing activities**

- Design and planning of Geological repositories
- Public/Political acceptance of geological disposal - *TECDOC-1566*
- The issue of retrievability and its technological impact
- Application of numerical modelling to GD programme (CRP's)
- Training and development of HLW disposal technologies (Network)
- Cooperation in shared disposal facilities (SNF)
  - Task on viability of sharing disposal facilities (2007-2010)  
Follow-up MNA expert group and TECDOC 1413



IAEA

**IAEA Documents**






IAEA

**IAEA Network of Centres of Excellence**



Training and Demonstration of Geological Disposal Technologies are the main objective of the IAEA Network of Centres of Excellence



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**IAEA Network activities**



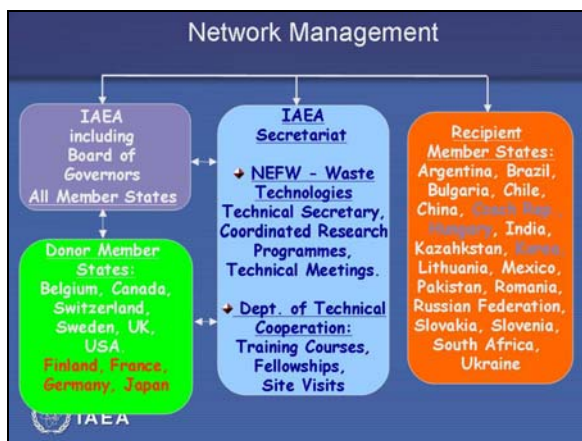
Provide research coordination  
➢ Through co-ordinated research projects

Support training  
➢ Through academic training courses  
hands-on group training, fellowships, (LBNL/DOE, GRC (Cardiff), ITC-School, etc.)

Facilitate knowledge transfer  
➢ Through workshops, scientific visits, exchange of documentation, etc.




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### Network Activities

**Main issues dealt with training courses between 2003 and 2007 on request of Member States:**

- Methodologies for GD (Fundamentals, Theory, Practice)
- Site Selection Procedures and Methodology
- Decision making and Stakeholder Involvement
- Repository design, construction and operation
- Numerical modelling with PRP data
- Numerical simulation of subsurface processes
- Deep Geological Repositories in Sedimentary Environments
- Transport and Retardation Processes in Fractured Rocks

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### Network Activities

**Course structure/programme:**

- Review/summary of the "State of the Art"
- Debates on issues of general interest
- Practical "hands-on" training provided/experienced
- Visits of facilities

**Fellowships and scientific visits for hands-on-experience, like:**

- Disassembly of the Tunnel Sealing Experiment (CAN)
- Heated tunnel test at YMP (USA)
- PRACLAY experiment (THM) at HADES facility (B)

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### Education and Training

- Request of a successful info preservation and transfer at all levels (operational, governance) and for relevant timeframes (intergenerational)
- Increasingly larger role played by communication, PR, social acceptability in WM issues
- Collaboration & partnership is the appropriate way to go by mobilising resources at international level
- Fora are requested to vehicle e.g. strategic planning & coordination of similar activities in world's regions. In this frame, IAEA is developing international networks.

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### Multinational Approaches (MNA) - Rationale

- Multilateral approaches are dealing with different aspects of the NFC
  - Reasons:
    - Capability for safe implementation of NWM programmes
    - Availability of human/financial resources, of host formations (disposal)
  - Advantages:
    - Economy of scale
    - Environmental and safety considerations
    - Security and non-proliferation
- No progress to date in shared repositories due to the lack of potential and capable countries willing to host multinational repositories. Reference scenarios: Add-on scenario, Cooperation scenario, International scenario.
- Need to further develop proposed scenarios, regarding the conditions for their successful implementation and the benefits and challenges inherent to such facilities (policy, legal, security, economic and technological incentives and disincentives)

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### Trans-boundary waste transfers Historical perspective

- Early 80's
  - Trans-boundary waste transfers (research reactor fuels)
- From 1976
  - Return of waste after reprocessing (F, UK) and swaps (substitutions) for more effective waste shipments
- 1986
  - Bilateral exchange agreements (e.g. Germany/Sweden)
- 2000
  - Acceptance of specific waste streams (e.g. LLW containing Ra from Spain to Hanford)
- On-going
  - Sealed sources

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### Initiatives for international storage/disposal

- Desk studies on RFCC's (1975) -economic/safety/safeguards/security aspects
- Expert group (1980) on the concept of international SNF storage but no demand
- Expert group (1982) on plutonium storage under international control, reactivated in 1993 (GC). Concept of IMRSS (International Monitored Retrievable Storage, -SNF & Pu) initiated by Germany and the USA
- Multilateral exchanges encouraged by the JC (2001). Shared initiatives is an opportunity for WMA to fulfil their tasks and responsibilities
- International arrangements by the Russian Government for import/storage of SNF, not for disposal (on-going)
- ARIUS initiative, EU SAPIERR (CATT) projects, etc

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### Follow-up TECDOC 1413

- Agreements/Liabilities (host/partner)
  - Host country assumes all future liabilities for the waste for a prepayment of the disposal price
  - Partner country retains ownership but both countries share future liabilities with respect to disposal
  - Easier for waste than spent fuel (having potentially future economic value)
- Legal and regulatory issues: Compatibilities between countries. Reconnaissance of SAPIERR exercise at European level
- Economics of disposal systems: Cost & cost structure. Reconnaissance of SAPIERR exercise at European level
- Others
  - Data on inventory and conditioning of RW
  - Storage versus disposal, etc

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## Viability of sharing facilities for the disposition of nuclear fuel wastes

### Objectives

- To give a comprehensive and updated overview of initiatives in relation with the regional/multinational disposal options or scenarios for SNF/HLW (GNEP, GNPI, RUS/US National Academies, STUK, Conferences)
- To see how changes in global attitudes towards nuclear power and potential developments may influence the viability of establishing MNA for spent fuel
- To address in more detail the key open technical and strategic issues previously identified and to identify areas in which further work could be done to advance the progress of MNA



## Some key issues

- Technical and institutional challenges**
  - Variety of waste, technologies and QMS
  - Variety of entities, responsibilities, regulations, DMP
  - Cultural and societal considerations
  - MNR life may extend beyond life of institutions in host/partners countries
- Sensitive issues (requesting treaties, conventions)**
  - Siting & transportation
  - Long term liabilities
  - Waste ownership
  - Licensing (waste compliance with WAC)
  - Financial aspects (risk in development phase)



## Fuel Repatriation

- IAEA has been involved for more than 20y in supporting international nuclear non-proliferation efforts for decreasing the amount of HEU (e.g. through the Reduced Enrichment for Research and Test Reactors (RRRTR) programme)
- IAEA has been facilitating progress in the Russian Research Reactor Fuel Return (RRRFR) Programme. Fuel repatriation has been more active for Research reactors through the conversion of HEU to LEU. Multinational initiatives could activate fuel repatriation for Power Reactor Fuel
- Reference is made to 2 recent publications at the 48<sup>th</sup> annual meeting from the INMM, Tucson, July 07
  - IAEA Perspective and Lessons Learned in Shipping HEU Spent Fuel to Russia
  - IAEA Support of Research Reactor HEU to LEU Fuel Conversion Projects



## RRRFR

- 1999 – US, Russian Federation (RF) and IAEA launch of RRRFR
- Implemented at the IAEA through Technical Cooperation (TC) projects
- Facilitated the return of 433 Kg of fresh HEU from 9 MS
- Completed first shipment of spent HEU fuel (63 Kg) from Uzbekistan in April 2006.

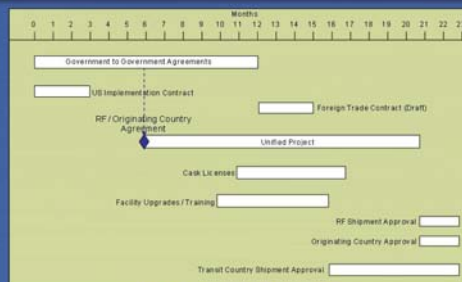


## RRRFR Lessons Learned Workshop – 10/06

- Provide technical/administrative information on preparations for shipping irradiated RRRF including the sharing experiences with Uzbek spent fuel shipments
- Finalise the outline and provide substantive documentation for preparation of an IAEA guideline document, and
- Determine actions to be taken by the IAEA to facilitate future shipments
- Regulatory and research representatives from 15 countries
- Covering legal requirements, contracts, facility preparations, transit issues, and transportation



## Uzbekistan – Lessons Learned




Integrated Schedule



### Fuel conversion

- Each project has been tailored to address the relevant constraints which often depend on several factors including the design of the reactor and fuel, technical needs of the MS, nuclear infrastructure, & available resources
- Poland, Portugal and Romania are examples on-going projects in RR conversion in EU
- EU Workshop on "International Legal Framework Applicable for Shipment of Russian-Origin Research Reactor Spent Fuel to the Russian Federation" - Poiana Brasov, Romania 24-26 April 2007 – Comprehensive presentations provided clear information regarding the EU legal and administrative obligations for EU Member States participating in the RRRFR program

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### Technical Cooperation - Romania

- 14 MW TRIGA-Reactor (Pitesti) fully converted in May 2006.
- Managed through a tripartite contract
- Challenged as the fuel fabrication operations were transitioning from USA to France
- Well managed with no adverse impact on the project




 IAEA

## A3-7. Presentation MARTIN O'CONNOR (University of Versailles, C3ED, France)

**Safety, Amenity, Emnity**

**Martin O'CONNOR**  
Professor of Economics  
Université de Versailles St-Quentin-en-Yvelines  
C3ED – Centre d'Economie et d'Ethique pour l'Environnement et le Développement

European Collaboration for Implementation of Long-Term Management Solutions for Spent Nuclear Fuel and Radioactive Waste  
Sofia (Bulgaria), 10-11 December 2007



**Long-Term Management Solutions for Spent Nuclear Fuel and Radioactive Waste**  
**ARE A TERRAIN OF**  
**CONFRONTATION & INTEGRATION**  
**AND ARE CHALLENGES OF**  
**SUSTAINABLE (?)**  
**TERRITORIAL DEVELOPMENT**




**RADIOACTIVITY STEWARDSHIP IS A CHALLENGE OF CONFRONTATION AND CONCILIATION**

Sustainability is the preoccupation – scientific, economic, moral & political – for reconciliation & coexistence of interests and forms of life that are in conflict with each other and at risk.

LONG-RUN RADIOACTIVITY STEWARDSHIP IS ONE OF THE TERRAINS WHERE THESE TENSIONS ARE EXPRESSED AND WHERE EXPERIMENTS MAY BE MADE FOR THEIR RECONCILIATION.

This requires the **MOBILISATION** of HUMAN AGENCY in relation to stewardship challenges and purposes

**THE 'BARBARISM' OF RADIOACTIVE WASTES**

« Nous partageons la conviction que chaque culture a beaucoup à apprendre des autres, qu'elle peut s'enrichir de nombreux apports. Il n'est pas sûr pour autant que chacun puisse jouer le jeu de la réciprocité, c'est-à-dire concrètement renoncer à sa 'barbarie' pour obtenir de l'Autre qu'il renonce à la sienne afin de permettre aux deux de jouir de leurs échanges réciproques. Comme il n'y a aucun espoir de fonder quoi que ce soit de durable sur l'escroquerie d'une pseudo-universalité imposée par la violence et perpétuée par la négation de l'Autre, le pari qu'il y a un espace commun de coexistence fraternelle à découvrir et à construire vaut la peine d'être fait. »

– Serge LATOUCHE, *L'Occidentalisation du Monde* (La Découverte, Paris, 1989), p. 139



## Theme A – “Building Durable Relationships with Radioactivity”

THE ENDURING PRESENCE OF HAZARDOUS WASTES IS BOTHERSOME AND REQUIRES A SOCIETAL RESPONSE.

Often, there is a feeling that, precisely because this lurking ‘risk’ is not easily forgotten, a solution that inspires confidence *must engage a permanent vigil in which concerned stakeholders are directly involved.*

This may involve stewardship procedures whereby an economically active community, in partnership with overall regulatory authorities, is living close to (or within) and *maintaining a watch over the waste/storage/site.*

THIS RELATION OF COMPETENCE REQUIRES STAKEHOLDER DIALOGUES.

## “BUILDING DURABLE RELATIONSHIPS WITH RADIOACTIVITY”

Strategies for living with radioactivity (the sites, the wastes...) must be built on three key aspects:

- **TECHNICAL AND SCIENTIFIC EXPERTISE:** the development, application and maintenance of scientific knowledge and technical competency to measure and to control the present and eventual exposure of living beings to radioactivity;
- **BUILDING SOCIAL/SOCIETAL RELATIONSHIPS WITH THE SITE:** the envisaging and invention, in social and symbolic terms, of how the relevant community (or communities) will relate to and interact with the sites, the risks, the wastes, the records, etc.;
- **POLITICAL/ECONOMIC PARTNERSHIP:** permitting to mobilise the relevant knowledge and resources for the implementation of an agreed societal strategy for stewardship.

## “BUILDING DURABLE RELATIONSHIPS WITH RADIOACTIVITY”

Activities of management, stewardship, remediation are sometimes quite ordinary tasks, although sometimes the cumulative processes are complex and uncertain.

There are many different ways that our societies, and future societies, might seek to appraise risks.

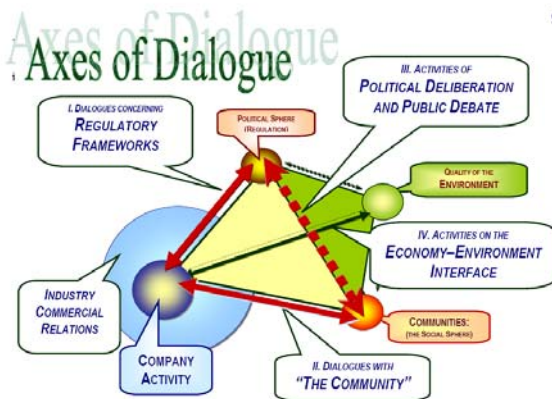
Remediation, site stewardship and waste management experiences can differ considerably from place to place, as regards the *relationships* (in social, economic, cultural and symbolic terms) that they establish between the people — individuals, classes, interest groups, succeeding generations, whole nations — implicated in the situations of production, storage and monitoring of the wastes.

This *social dimension* cannot be deduced from technology and the medical and bio/physical information set. This is why communication amongst stakeholders, and between technical experts, decision makers and civil society, is essential and is also a complex and context dependent challenge.

## THEME B — BUILDING STAKEHOLDER DIALOGUES

*In order to assess to what extent or on what basis the members of a society will judge acceptable (or not) a given radioactivity management strategy, it is necessary to consider the meanings and relationships (in social, economic, cultural and symbolic terms) that alternative remediation and stewardship strategies might establish between the people — individuals, classes, interest groups, succeeding generations, whole nations — implicated in the site/stewardship process.*

STAKEHOLDER DIALOGUES CANNOT ELIMINATE CONFLICTS, COMPLEXITIES AND UNCERTAINTIES. But they can be used to help build up a clear picture about the merits and demerits of waste/site stewardship alternatives that present themselves to the relevant authorities and stakeholders in the society.



## [B.0] — “BUILDING STAKEHOLDER DIALOGUES”

Three points must be addressed in order to build a structured stakeholder dialogue process around strategies for living with radioactivity

- First, there must be an explicit identification of the relevant **STAKEHOLDERS**, and the establishment of an institutional framework within which exchange of information and opinions can take place.
- Second, there must be a clear picture of the relevant site management **OPTIONS**. For example, remediation and long term site stewardship issues and options can be explored in terms of a small number of scenarios each of which expresses distinct technological, economic and governance features. Sometimes stakeholders can be solicited to contribute to the framing of these scenarios.
- Third, there must be a clear expression of the **CRITERIA** for selection of the stewardship strategies, with the variety of different criteria reflecting the full diversity of societal concerns.

## [B.1] — CHECKLIST: WHAT SORT OF SITUATION ARE WE IN?

- Q.1. Should there be official recognition of a waste, residual risk or contamination problem?
- Q.2. If yes, Should there be active stewardship of the site?
- Q.3. Is there, or is there planned to be, or should there be an ongoing public interaction with the site?
- Q.4. Should the historical liability be made into a feature of the site's new identity and use?
- Q.5. If yes, What sorts of activity are or should be associated with the contamination or waste features, e.g., public good activities such as education, training and research; or private benefit activities such as recreation, tourism?
- Q.6. What sort of socio-economic profile, prestige or importance should be associated with the stewardship process?

## [B.1 BIS] — FROM CHECKLIST TO TYPOLOGY OF “OPTIONS”: STEWARDSHIP/REMEDIATION — WHAT SOCIETAL MODEL?

- The response to Q.1 might be No, but with an ongoing controversy....
- The sequence [Q.1 Yes, Q.2 No] would imply identification of a passive remediation, or of an ‘orphan’ site (haunted house, ghost town, etc.).
- The sequence [Q.1 Yes Q.2 Yes Q.3 No] would lead to concepts of a segregated or isolated site, with restricted access. Appropriate analogies might be a dangerous natural site, a rubbish dump, a warehouse for storing dangerous goods, a mausoleum, and, on a different plane, a hospital or nursing home.
- The sequence [Q.1 Yes Q.2 Yes Q.3 Yes Q.4 No] leads to suggestions for “ordinary” uses of the site, e.g., industrial or forestry production, or recreational activities (such as a golf course) that do not in any way rely on (or ‘exploit’ the stewardship status of the site).
- The sequence [Q.1 Yes Q.2 Yes Q.3 Yes Q.4 Yes] leads to suggestions for uses of the site that specifically ‘exploit’ the historical liability as a distinctive feature. This could include commercial uses that play on the identity of the site (e.g., advertising a golf course with grass that glows in the dark?), or installations such as a shrine museums and educational facilities.



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### [B.2] — RADIOACTIVITY STEWARDSHIP CRITERIA

#### QUALITY PERFORMANCE PRINCIPLES / ETHICAL BOTTOM LINES

- PR.1 Have the responsibilities of existing parties been appropriately assigned?
- PR.2 Have responsibilities 'towards other parties' in the short term been adequately addressed?
- PR.3 Have responsibilities 'towards other parties' in the longer term been adequately addressed?
- PR.4 Has available technical knowhow and systems science been mobilised?
- PR.5 Is the solution economically viable?
- PR.6 Does the solution enhance the prestige of the host communities and other stakeholder groups closely associated with the residual/waste site?

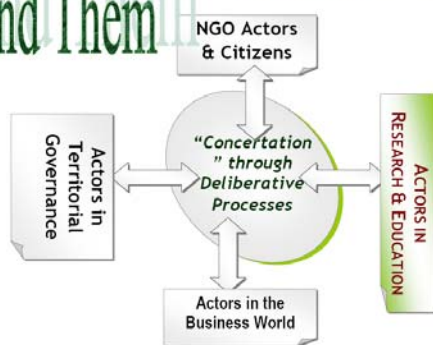
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### DETAILED CHECKLIST: RADIOACTIVITY STEWARDSHIP PERFORMANCE PRINCIPLES (MULTIPLE AND SOMETIMES CONTRADICTORY QUALITY/RESPONSIBILITY CRITERIA)

- PR.1 Have the responsibilities of existing parties been appropriately assigned? For example:  
Application of a principle of mutual autonomy-responsibility (each care of your own waste: at residual state)  
Application of the principle that "the polluter pays"  
Clear expression of, and respect for, local, national and international regulatory conditions.
- PR.2 Have responsibilities 'towards other parties' in the short term been adequately addressed? For example:  
Security measures to monitor and the public as well as close to the site.  
Security against attack in the face of repeated or potential sources of aggression.
- PR.3 Have responsibilities 'towards other parties' in the longer term been adequately addressed? For example:  
A 'sustainability' principle of inter-generational responsibility (don't pass on problems to others that you cannot cope with yourself).  
A thorough characterisation of radio-nuclide waste (with reference to: dangerous substances, engineering works, living environment, future societal evolution);  
An application of some or more of the principle of precaution.  
Is there likely long-term mobility of the necessary knowledge base (e.g., transmission of records, specialist know-how, local knowledge) for competent stewardship?
- PR.4 Has available technical knowhow and systems science been mobilised? For example:  
Repurpose (profiling the technical, medical and ecological aspects) of the exposure risks.  
Standard of best practice (technical reliability, compliance...)  
Monitoring procedures effective to the full spectrum of identified radio-nuclide waste consequences.
- PR.5 Is the solution economically viable? For example:  
Are the immediate costs of stewardship affordable with the available resources?  
Clear picture of the trade-off and relationship between clean up and stewardship  
Are the solution: cost-effective for the standard risk reduction results?  
Are there major financial costs: limited into the future?  
Reasonable prospects of building resources for the financial stewardship costs in the longer term?
- PR.6 Does the solution enhance the prestige of the host communities and other stakeholder groups closely associated with the residual/waste site?  
Visible partnership between local and national stakeholders (e.g., agreed distribution of responsibilities; legal mandate for stewardship activity; agreement on basis for financing of different cost components, etc.)  
Site (re)definition: clearly its evidence?  
Local cooperation: clearly its evidence?  
Well defined framework for ongoing involvement of stakeholders in stewardship oversight and review;  
Limits to site extension and/or using activities at local and wider scales.

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### [B.3] — WHO ARE THE STAKEHOLDERS (?)



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### [B.3/1] — US & THEM: THE STAKEHOLDERS IN SUSTAINABILITY

#### COEXISTENCE: CONFRONTATION AND CONCILIATION

Sustainability is the preoccupation — scientific, economic, moral & political — for reconciliation & coexistence of interests and forms of life that are in conflict with each other and at risk. For example:

- Between 'growth' and the 'protection of the environment'
- Between 'us' and the 'other' (e.g., NIMBY)
- Between present and future generations (Brundtland's sustainability)
- Between self-interest and interest in the lives of others (problems of altruism, duty, responsibility)
- Between the human and the non-human world (including "intrinsic value")
  - Between 'our' culture and other cultures (racial, ethnic, religious intolerances & incomprehension)
- Between what is 'internalised' in the marketplace and the 'externalities'
- Between any given region or territory and its "Rest of the world"

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### [B.3/2] — US & THEM: STRATEGIES OF DOMINATION & COEXISTENCE

#### - SUSTAINING OF WHAT, WHY, FOR WHOM? -

The articulation of sustainability as a *problem of social choice* highlights a tension between two forms of discourse and action:

- Self-centred attitudes, associated typically with discourses of control or of domination, seek to pursue or to impose one's own set of purposes with (1) the containment of the Other through exercise of power or wiles; and (2) the exclusion or discounting of any contradictory claims of what is true, good or valuable, to be respected or merits to be done;
- Other-open attitudes: Pragmatic, sometimes generous, sometimes ironical attitudes that propose to search out possibilities of a durable coexistence based on establishing 'tolerance' and, thus, defining a 'respectful' or even 'friendly relation' with the Other.

*The two forms are not exclusive; they are in dialectical relation.*

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### [B.3/3] — US & THEM: CONFRONTATION AND CONCILIATION WITH THE WASTES

- Every organism, species or cultural form affirms its specificity and its survival needs in relation to the rest of the world, while at the same time inhabiting (and depending on) that world in its richness and diversity.
- In the case of radioactive wastes, which are our own creation, we can hardly treat them as our enemy, yet must be respectful of the dangers that our progeny pose!
- So an attitude of friendly watchfulness seems called for:

▪ **KEEPING THE WASTES IN THEIR PLACE!**

▪ **'GETTING ALONG WITH THE WASTES'**

<sup>1</sup> The famous tragic story of Dr. Frankenstein's Monster (who, unable to find love and empathy, brought moral and physical ruin to his creator, is not quite the same but highlights the pathos that is one facet of confrontation and coexistence.

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### [B.3/4] — US & THEM: WASTE STEWARDSHIP AS A PUBLIC AMENITY

The conviction in the need for investing in a social mechanism for "getting along with the wastes", arises paradoxically, from the challenge of putting meaning and satisfaction into unavoidable tasks — such as hospital care and house-cleaning — that are not intrinsically sources of pleasure but are part and parcel of communities.

The societal/policy challenges thus are for building consideration (1) for the wastes as "fellow travellers" in our technological and cultural adventures, and (2) for the community energies necessarily engaged in the waste stewardship tasks.

"... It is by no means sure that each party can play the game of reciprocity, that is, concretely renounce his/her 'barbarism' so as to obtain from the Other that s/he renounce his/her own, permitting the two to find pleasure and profit in their reciprocal exchanges... Yet, as there is no hope of founding anything durable on the short-change of a pseudo-universality imposed by violence and perpetuated by the negation of the other party, the venture is warranted that there is indeed a common space of fraternal coexistence yet to discover and construct." — Serge Latouche (1989, p.139)

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## THEME C — How To Do It?

### SUSTAINABILITY POLICY & DIALOGUE

"... the policy process will enter the realm of the hermeneutic where there is no prior agreement on the key questions, appropriate framework or essential facts. With an expansion of worldviews and a broader conception of knowledge, we will find little consensus on questions, methodologies and data for determining optima. Good policymakers will be those who can lead enlightening conversations between scientists with different disciplinary backgrounds and between people of different cultures and knowledges."

— Richard Norgaard (1988), "Sustainable Development: A Co-evolutionary View", in *Futures*, 20, pp.606-620.



## Long term Radioactivity Management

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... IS A RECURSIVE MULTI-STAKEHOLDER PROCESS

- ❑ Mobilising Knowledge and Material Resources
- ❑ Developing & using Analytical Frameworks (e.g., Models<sup>2</sup>; Maps, sets of Scenarios);
- ❑ Framing normative assumptions (e.g. Indicators & Reference Values for Multi-Criteria assessment);
- ❑ Ex post or ex ante Evaluations of policy & performance;
- ❑ Negotiating Purposes and Communicating Results...

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### [C.1] — PARTNERSHIP BUILDING VIA STAKEHOLDER DIALOGUES

**DECISION-MAKING IS AN ARGUMENTATIVE OR DELIBERATIVE PROCESS, "one of raising questions and issues towards which you can assume different positions, and with the evidence gathered and arguments built for and against these different positions."**<sup>2</sup>

WELL STRUCTURED PARTICIPATORY PROCESSES CAN HELP WITH:

- Identification and development of elements of common problem definition and common language for all the parties concerned;
- Understanding of the assumptions underlying expert solution proposals and evaluation techniques, of the terms in which these techniques can contribute to reasoned decisions, and limitations to their application;
- Sharing of reasons and justifications brought by different social groups;
- Status and respect given to participation by professionals and lay people.

<sup>2</sup> Rittel, H. (1982), "Systems Analysis of the First and Second Generations", pp. 35-63 in P. Lecoate, J. Gibson, A. Rapoport (eds, 1982), *Human and Energy Factors in Urban Planning*, NATO Advanced Study Institutes Series, Martinus Nijhoff, The Hague.

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### [C.2] — STRUCTURING STAKEHOLDER DIALOGUES

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### [C.3] — TOOLS & METHODS: E.G., THE 'DELIBERATION MATRIX'

**KERDST — THE KERBABEL™ DST ON-LINE**

KERDST is an on-line tool, offering to users a multi-stakeholder multi-criteria deliberation framework that can be applied to any situation of debate.

**Each cell (x,y,z) in the KERDST DELIBERATION MATRIX represents one dimension of the evaluation:**

- ... by a specified category of **STAKEHOLDERS** (y),
- ... of a **SITUATION** or a **SITE** or a possible future **SCENARIO** (z),
- ... with reference to one of the **PERFORMANCE CRITERIA** (x) (e.g., Societal Quality-Performance Bottom Lines)

SEE KERDST ON-LINE AT: <http://kerdst.c3ed.uvsq.fr>

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Screen-copy from: <http://kerdst.c3ed.uvsq.fr>

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## Sustainability Assessment

● MULTI-STAKEHOLDER ● MULTI-SCALE ● MULTI-CRITERIA ●

SA LEVEL	OUTCOMES OF THE PROCESS
AN EX POST OR EX ANTE ASSESSMENT	COMMUNICATION OF THE RESULTS OF AN ASSESSMENT of a situation, or comparative appraisal of options for action.
MOBILISING BASKETS OF INDICATORS FOR EACH PERFORMANCE CATEGORY	Consensus about baskets of appropriate indicators to be mobilized, as a function of the assessment needs, issues and targets, stakeholder diversity, etc.
INDICATOR CATALOGUES FOR EACH SA CONTEXT OR CLASS OF PROBLEMS	Banks of 'candidate indicators' (data and meta-information) available to be mobilized, as a function of the issues, range of sites, scales and strategies (etc.).
KNOWLEDGE QUALITY ASSESSMENT	KQA profiles, characterising the <i>credibility, reliability and pertinence</i> of Indicators, models & data, relative to the <i>risks, uncertainty and controversy</i> as governance challenges.

SOURCE: SRDT/OXLES — "METHODS AND TOOLS FOR EVALUATING THE IMPACT OF COHESION POLICIES ON SUSTAINABLE REGIONAL DEVELOPMENT" (EC 6th Framework Programme, Contract No. 502485, 2005-2006)

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### [C.4] — KQA AND STAKEHOLDER DIALOGUES

**KQA — Scientific knowledge quality assessment** (e.g., NUSAP profiles) — requires reflexive scientific expertise; but also (and more particularly...) — it requires ongoing dialogues between "producers" and "users" of knowledge (information).

Knowledge of What ???	(What is the 'Object' of Representation) (Observation/Visualisation at what scales?)
QUESTIONS OF PERTINENCE ARISE...	
Pertinence Why ???	What are the Stakes? The Issues?
Pertinence to Whom ???	Who (and where) are the Stakeholders?
Pertinence Where ???	In what senses a Local / Global problem?

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### [C.5] — KEY META-INFORMATION CATEGORIES FOR SA

Knowledge management, for any assessment context, proposes fields that permit users to declare views on the **PERTINENCE** of an indicator *relative to*:

- ❑ each of the **"PERFORMANCE ISSUES"** identified for the multi-criteria evaluation
- ❑ each of the **Actor/STAKEHOLDER CATEGORIES** of deliberation perspectives
- ❑ the organisational **SCALE(S)** at which the indicator is applicable
- ❑ each of the **SITES** or activities or situations where SA is made or envisaged.

On-line knowledge management tools can also provide declaration & documentation formats for:

- ❑ specification of indicator values or ranges for **SCENARIOS**.
- ❑ **KQA PROFILING**, including uncertainties of current data and indeterminacies associated with indicators & models in scenario exercises.
- ❑ Specification of normative **REFERENCE VALUES** (or ranges) for assessing past, current or scenario outcomes against scientific & societal benchmarks.

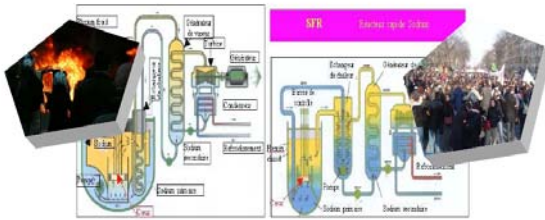


### SUMMING UP (1)

- This 'generic' Sustainability Assessment (SA) method is socially robust, in that it can be applied meaningfully...
  - ... with very incomplete information sets;
  - ... with a great diversity of 'candidate indicators';
  - ... in a dynamic way (both contributing to and benefiting from improvements in the supporting information sets).
- It can also be applied meaningfully
  - ... with very modest technical expertise;
  - ... and to build dialogues between constituencies holding very disparate knowledges and expertise.
  - ... and to highlight that technical and societal competence are not disjoint...

### SUMMING UP (2)

- Commitment to a stewardship role, or to cooperating with site stewards, can emerge alongside and through mis-understandings, disputes and conflicts.
- Processes of information sharing and debate can be powerful for building good will, respect and trust.
- A constructive stakeholder interaction can permit the emergence of novel solution ideas, including compromises between different performance criteria.




Thank You

## A3-8. Presentation JUHANI VIRA (Posiva Oy, Finland)

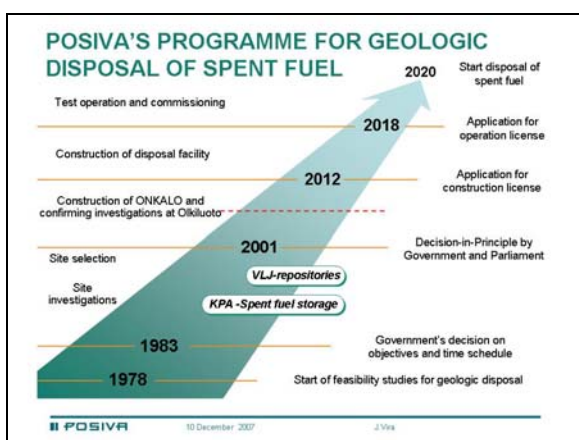
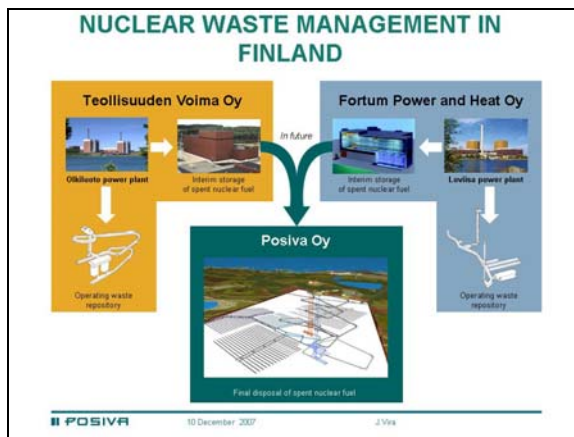
**SKB/POSIVA:  
A LIVING COLLABORATION**

Juhani Vira  
Posiva Oy  
Finland

10 December 2007



POSIVA



**PROGRAMME START IN 1980'S: BACKGROUND**

- four nuclear power plant units on line
- accident at Three Mile Island leads to increased concerns about use of nuclear power
  - Swedish referendum
- general plans for waste management have been made assuming future reprocessing of spent fuel
  - TVO in talks about contracts with BNFL, Cogema
  - IVO (later Fortum Power and Heat) sends the spent fuel back to Soviet Union
- high prices for reprocessing, uranium price collapse lead to second thoughts
  - TVO withdraws from negotiations with reprocessors

POSIVA

**GOVERNMENT DECISION 1983**

- (in the absence of reprocessing contracts) TVO should either seek for possibilities to send their spent fuel abroad permanently, or
- start a systematic programme for direct disposal of spent fuel in Finland
  - future milestones defined: site selection in 2000, repository construction start in 2010's, start of disposal operations in 2020

*TVO studies possibilities for "foreign solutions", but decides to start a programme aiming at geologic disposal of spent fuel in Finland.*

POSIVA

**PROGRAMME PRIORITIES**

- SKB ('s predecessor) have already developed a concept for direct disposal in Sweden
- Finnish bedrock similar to Swedish bedrock
- fresh fuel elements are fabricated in Sweden

⇒ TVO adopts the KBS-3 concept.

- SKB presents a comprehensive safety evaluation for KBS-3 in 1985
- public opposition expected to siting proposals

⇒ TVO sets the programme focus on siting.

POSIVA

## COOPERATION BETWEEN TVO, IVO AND SKB

- agreement on information exchange in 1987
  - regular meetings on various organisational levels
  - personal contacts
  - joint development of canister concept ("ACP" Canister)
- agreement on supply of expert services
- SKB-TVO agreement on cooperation at Äspö Hard Rock Laboratory (1992)
  - participation in selected projects
  - participation fee, in-kind contributions
- all contracts later transferred to Posiva

POSIVA

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J.Viik

## ENHANCED COOPERATION BETWEEN SKB AND POSIVA (1999-)

- MoU on strengthened cooperation in 1999
  - Joint Steering Group for cooperation
  - start of preparation for agreement on technical cooperation
- Five-year agreement on extensive technical cooperation between SKB and Posiva in 2001
  - focus on encapsulation and repository technology
- Agreement renewed in 2006 for another five years
  - comprehensive cooperation in all areas of geologic disposal of spent fuel

POSIVA

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J.Viik

## 1st AGREEMENT (2001)

- background:
  - SKB's progress in encapsulation and repository technologies
  - Posiva's progress in siting
- aim: win-win benefits in resource utilisation and RTD costs
- prerequisite: settling the imbalances in prior information held by the parties
- coverage: focus on encapsulation and repository technologies
- stipulations on:
  - coverage
  - management and organisation
  - cost sharing
  - reporting
  - ownership of information, intellectual property rights
  - inventions, patents
  - liabilities, warranties

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J.Viik

## COOPERATION IN CANISTER MANUFACTURING



- Copper billets
  - Cast technology development
- Copper canister - from a billet to a tube
  - Pierce & draw
    - Integrated bottom
    - Method optimization for the bottom
  - Extrusion
    - The most advanced method,
    - The latest tubes fulfill requirements
  - Forging
    - Tool development
- Cast iron insert
  - Posiva inserts cast at a foundry in Finland
  - Integrated bottom
  - SKB insert cast trials at three foundries in Sweden

POSIVA

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## CANISTER SEALING

### In Finland:

- Electron beam welding at high vacuum developed
  - Trials with various equipments at several companies and institutes during 10 yrs
    - Understanding developed and basic parameters found
- Now in cooperation with Patria Aviation Oy
- Programme: plate tests during 2004, lid welding tests during 2005-2006, demonstration weldings 2007-2008



### In Sweden:

- Low vacuum EB-welding
  - Method and equipment development
  - Full-length canisters welded at SKB Canister Laboratory
- Friction Stir Welding
  - The 1st full-length canister welded in Spring 2004 at SKB Canister Laboratory

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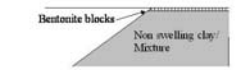
J.Viik

## BACKFILLING TECHNIQUES

### A: Ballast/Bentonite in situ compaction



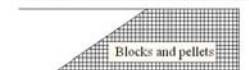
### C: Non swelling backfill and blocks at roof



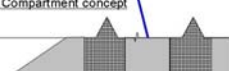
### B: Swelling clays, in situ compaction



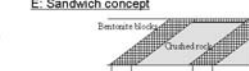
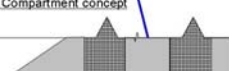
### D: Emplacement of pre-compacted blocks



### E: Sandwich concept



### F: Compartment concept

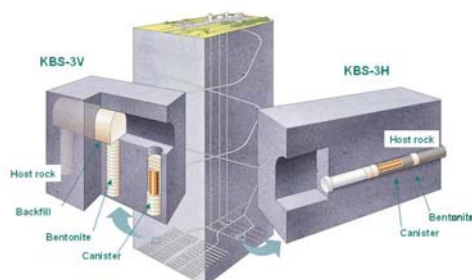


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## FEASIBILITY ASSESSMENT OF KBS-3H



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## 2nd AGREEMENT (2006)

- background: positive experience on enhanced cooperation through the first contract period
- aim: as before; mutual support in licensing
- coverage: all areas of geologic disposal of spent fuel
- stipulations: similar to those in the earlier contract plus more detailed rules for technology ownership and transfer
  - revised organisation: Steering Group – Programme Directors – Project Managers
  - revised principles for cost sharing

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J.Viik



## ACHIEVEMENTS OF CURRENT COOPERATION

- over 80 joint projects carried out in 2001—2006
- division of work reduces overlapping RTD efforts
  - save planned redundancy (to maintain alternative options in key areas)
    - e.g., welding techniques
- obvious cost savings
- rapid transfer of experience, early awareness of issues
- larger data basis, broader expertise for planning of future work and argumentation on safety of disposal

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J Vika

## PROBLEMS ENCOUNTERED

- different time tables lead to different priorities, different regulations give rise to different requirements
  - limited cooperation in actual safety case development
  - relatively few joint efforts in site investigations (active personal contacts maintained)
- lack of expert resources (Posiva) cause imbalances in staffing of activities and inefficiency in transfer of knowledge and experience
- different organisational cultures sometime cause additional strains on practical cooperation

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J Vika

## FUTURE CHALLENGES

- comprehensive cooperation means effective ties between programmes
  - problems/issues in one country easily move over to the other as well
  - choices in one country will probably affect choices in the other
  - the regulators in the two countries have found each other as well
  - however: cooperation gives better position for solving the issues
- planned shift from RTD to implementation will change the context of cooperation
  - new options for cooperation likely to open

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J Vika

## CONCLUDING COMMENTS

- programme for geologic disposal of spent fuel is possible without excessive costs, but
- TVO's/Posiva's programme owes a lot of its success to international contacts and cooperation
  - information and experience provided by SKB has been of special importance
- access to international information and cooperation made it possible to focus the work on site and site-specific topics
  - no language barrier to Swedish RTD information
- presently strong political consensus on "solving the nuclear waste problems in the waste producer's own country"
  - in contrast to recommendations for "foreign solutions" in the early 1980's
  - sets constraints to international cooperation

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## GENERAL COMMENTS

- international contacts and cooperation make sense only in the context of a sufficiently extensive own programme
  - information transfer and application otherwise difficult to realise
  - with increasing stakes the fairness of cooperation also becomes important
- the ties created by close cooperation need to be acknowledged and accepted
- differences in the national contexts and conditions need to be acknowledged
  - and may become increasingly difficult as the number of partners increases

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### A3-9. Presentation IRENA MELE (ARAO, Slovenia)

## Small Nuclear Programmes' Needs

Irena Mele  
ARAO, Slovenia

Sofia, Bulgaria, 10 - 11 December 2007

1

## Outline

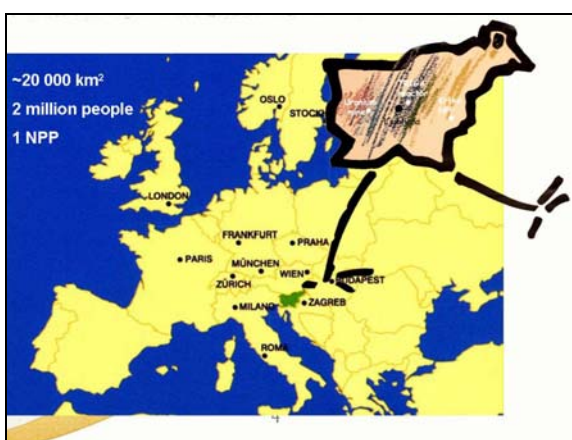
- Problems and high sensitivity of small nuclear programme(s)
- Differences between large and small programmes
- Needs of small programmes
- What can be done by cooperation and why shared solutions are important

2

## What is small programme?

- Definition not clear
- Usually related to the small number of nuclear power plants but correlation not always adequate
- Sometimes correlation made to small country, but it may be misleading
- Whatever the definition - Slovenia is a good example of small nuclear programme and small WM programme

3



## Problems of a small nuclear programme

- Small number of NPPs and small quantities of waste
- Very often no other nuclear industry or development in nuclear technology
- Limited resources:
  - Financial
  - Human resources
- Limited technical capabilities
- Limited research potential

5

## But the same demand....

- To fulfill safety standards and safety requirements in operation of NPP(s)
- To develop and implement the Nuclear legislation
- To establish the Safety Authority
- To provide qualified staff
- To conduct WM in accordance with internationally recognized good practice:
  - to clearly allocate responsibilities for WM (special organization for WM/disposal)
  - to provide a (national) disposal solution

6

## Not only cost of disposal...(1)

Country (year of estimate)	SNF(t)	Cost/t (in mio EUR)
Belgium (2000)	4'320	±0.39
Canada (1991)	95'000	0.081
Czech Rep. (1999)	3'724	0.34
Finland (2000)	2'600	0.39
Hungary (2000)	1'300	1.19
Japan (2001)	54'000	0.32
Slovakia (2000)	2'500	0.58
Sweden (2001)	9'000	0.32
Switzerland (2001)	3'000	0.90
USA (2000)	70'000	0.57

(1) From report of C. McCombie

7

## ...which is increasing with time(1)

Country	SNF (t)	Cost/t (mio EUR)
Finland (2006)	5500	0.55
Sweden (2006)	9000	0.46
USA (2006)	70000	0.74

(1) Data taken from [www.skb.se](http://www.skb.se), [www.posiva.fi](http://www.posiva.fi), [www.ocrwm.doe.gov](http://www.ocrwm.doe.gov), [www.yuccamountain.org](http://www.yuccamountain.org)

8

## Disposal cost for Slovenia

- At the time of construction of NPP it was believed to be few % of initial investment
- 1996: cost estimate for SF disposal in decommissioning plan 0,37 - 0,55 mio \$/tU
- 2004: in revised decommissioning & disposal programme 0,82 mio €/tU
  - it includes no research or development
  - assumes smooth siting
  - some estimates on lowest possible level
- Fear that the new estimates will increase the cost

9

## Effect of rising cost

- Money for disposal collected from only 1 NPP
- In case of further increase of disposal cost:
  - NPP may become uncompetitive
  - Fund for decommissioning not sufficient
- In both cases huge consequences for small economy

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## Development of disposal solution

- In developing phase R&D needed
  - R&D more and more specialized and expensive
  - Underground laboratory research required for the development of a repository
- Only big nuclear programmes can afford it
- Small nuclear programmes
  - often unable to actively participate but
  - obliged to follow and
  - expected to develop their own disposal solutions

11

## Participation in R&D?

- Very important but difficult to afford because:
  - low financial resources
  - scarce human resources
  - small research potential
  - available research capacities used to support safe operation of nuclear facilities
- Low interest because solutions are needed in far future

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## Large time-scales

- Need for disposal time-distant - low intensity of activities
- Fear of lack of experienced staff in the future
  - Better job opportunities and career prospects in other (nuclear) fields
  - In the past the inflow of nuclear professionals from other fields to WM, in the future such trends will be stopped
  - Difficulties in getting well qualified staff
- Shortage of students and less possibilities to maintain the (quality of) E&T process

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## Small is beautiful.....

- ... but costly ....and restrains options and possibilities
- In some areas "small" can be used as a niche and good business opportunity
- In other areas it means being uncompetitive or even being "out of game"
- "Boutique WM" (to do everything on our own) not feasible for small programmes in an open electricity market

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## Large programmes - small programmes

- For same safety standard in small nuclear programmes much higher cost of necessary infrastructure per kWh
- Fewer operators to pool the resources for future nuclear liabilities
- Small quantities of waste - high unit disposal cost which needs to be covered by few waste generators (higher burden for produced kWh)
- Small programmes often do not reach critical mass to conduct independent and efficient disposal programme

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## High sensitivity of small programmes

- In disposal strongly dependent on large programmes - almost no choice but to follow
- Small programmes highly sensitive to decisions of large programmes - decisions may have huge consequences
- Confined in a situation with no good solution:
  - Costly disposal may jeopardize the competitive energy production
  - Earlier closure will not provide sufficient resources for nuclear liabilities
  - Non-competitive nuclear energy will not justify new nuclear build

16

## Present situation in WM

- National solutions highly preferred
- Joint efforts and multinational solutions in WM recognized, but:
  - still many reservations and mistrust, especially in shared repositories
  - lately support of IAEA and EC
- Transfer of technology possible in principle but technology tailored to specific national conditions and capacities planned only for national needs
- No ready-made or adjustable designs
- Services for specific disposal technologies not available
  - Encapsulation
  - Canister production
- No shared facilities

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## From the perspective of small programme

- Deferred decision and keeping options open a temporary way out from present difficulties
- Pooling capacities and sharing facilities may help small programmes to make disposal affordable:
  - but many difficulties in practice (technical, political, societal,...)
  - no interest to host such facility
  - lack of support from large programmes
- Support of developed programmes needed
  - by ready-made and/or adjustable products
  - in form of services
  - by facilitating the technology transfers
  - by knowledge transfer and training
  - by shared facilities
- Also important to provide good examples with implementation of national solutions

18

## New build?

- Waste disposal may in small programmes present a serious obstacle for new build of NPP:
  - Decision-making process and licencing procedures will require answers on future SFM
  - High-cost of disposal may be prohibitive for small and new programmes
  - With no new build small programmes will not reach critical mass and make disposal more affordable
- Negative impact on nuclear renaissance, negative environmental impact

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## Conclusions

- Co-existence of national and shared approach to disposal is possible and could be beneficial for large and small programmes
- Support to small programmes needed - not as a "free lunch" but for fair price:
  - In R&D
  - By ready-made and adjustable designs
  - By facilitating the technology transfer
  - By providing services for specific high-tech processes
  - By encouraging pooling the resources for shared facilities
- Supply of products and services from front-end should be extended also to back-end

20



21

## A3-10. Presentation ALAN HOOPER (United Kingdom)

### ***“What the technology owning countries (TOC) can offer and what they might want in return”***

Presentation to CATT-SAPIERR Workshop,  
Sofia, 10-11 December, 2007  
**Alan Hooper, United Kingdom**

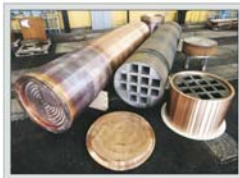
#### What TOC's can offer – Know How

- technology
  - hardware
  - Repository designs / drawings / technology
  - software and data
  - quality management systems
- skilled personnel
  - technical experts and teams
  - managers / strategic thinking
- services
  - encapsulation
  - reprocessing
  - transport
  - containers
  - specialised R&D facilities

23/01/2008

2

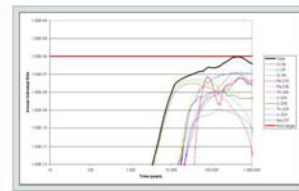
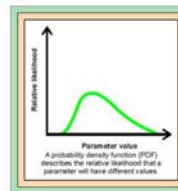
#### Hardware



23/01/2008

3

#### Software and data



23/01/2008

4

#### Other aspects

- Quality management systems
- Technical experts and teams
- Management
- Regulatory aspects of waste management projects
- Stakeholder networks

23/01/2008

5

#### Additional thoughts

- Re SAPIERR:
  - TT can apply to regional facilities
    - RR – mix of fuels, waste types, larger inventory etc.
    - Safety case development
- Provide input to international exercises
  - working through international organisations
  - establishing co-operation networks

23/01/2008

6



### What the TOCs might want in return

- confidence and credibility re technologies/approaches
- return on their investment in IP
- retain expertise
- new ideas/feedback from potential users

7

23/01/2008

### Concluding remarks

- Not just a business arrangement
- Benefits for all parties
- Timing of respective programmes is critical to nature and participation in co-operation

8

23/01/2008

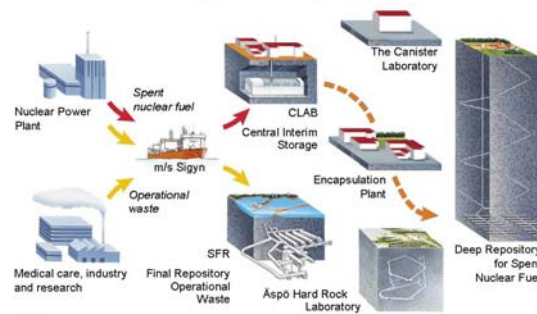
## A3-11. Presentation MONICA HAMMARSTRÖM (SKB, Sweden)



Model for sharing and transfer of knowledge in the field of radioactive waste management - both non-commercial and commercial

Monica Hammarström

### The Swedish system



SKB

Workshop Sofia Dec 10-11 2007 2

### System in operation



1982

1985

1988

SKB

Workshop Sofia Dec 10-11 2007 3

### Facilities for research, development and demonstration



SKB

Workshop Sofia Dec 10-11 2007 4



The owners



#### Collaboration partners

Universities and colleges of higher education, consulting companies, the Geological Survey of Sweden (SGU), organisations and institutions



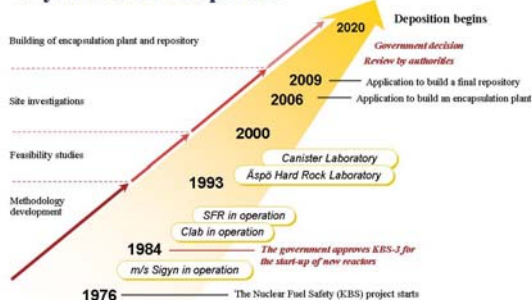
Workshop Sofia Dec 10-11  
2007 5

## Authorities and legislation



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2007 6

## 40 years of development



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2007 7

## International Cooperation - History



- Broad international reviews of KBS-reports created networks (1978-84)
- International Stripsa Project, OECD/NEA (1980-1992)

- 9 member countries (US, FI, CA, CH, FR, JP, SE, UK, ES)
- in-situ tests needed (characterization methods, modelling of groundwater flow, design of EBS)
- high costs of experiments motivated cooperation (total 27 MEuros during 13 years)

#### Conclusions drawn

- scientists in all participating countries gained experiences
- good base for development of national programmes
- cost-effective
- good base for future projects



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2007 8

## The cooperation continued at Äspö Hard Rock Laboratory



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2007 9

## Cooperation models

- Bilateral general information exchange
  - Objectives: exchange of information in the field of nuclear waste management of benefit for both parties.
- Project Agreements Äspö HRL and modelling Task Forces
  - Objectives: Ensure high scientific level of R&D to support the Swedish programme
- Cooperation agreement with Posiva, Finland



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2007 10

## SKB IC - SKB's international service

- SKB's primary mission is to manage the waste from the Swedish nuclear power programme. The programme is financed through the Swedish Nuclear Waste Fund (NWF).
- SKB decided already in 1984 to manage international consulting and know-how transfer through a special division to ensure:
  - Clients can expect dedicated staff and quality assurance
  - No use of Swedish NWF fund for international services
  - Fair compensation for investments made by SKB's owners
- In 2001 this division in SKB responsible for commercial services was transformed into a legal entity. SKB IC is still an integrated part of SKB!



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## Conclusions

- Open information exchange will continue to be very important both for technical and political reasons
- Entering into detailed design and licensing imply that technical solutions of commercial interest are available
- A reasonable balance between open information and knowledge and that of commercial value has to be maintained.



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## A3-11. Presentation RADOSVETA MARKOVA-MIHAYLOVA (BNRA, Bulgaria)

**NUCLEAR REGULATORY AGENCY**

### Management of HLW and LILW-LL in Bulgaria

Radosveta Markova-Mihaylova  
Nuclear Regulatory Agency, Bulgaria  
E-mail: R.Markova@bnra.bg

Workshop on European Collaboration for Implementation of Long Term Management Solutions for Spent Nuclear Fuel and Radioactive Waste  
Sofia, Bulgaria, 10-11 December 2007

**NUCLEAR REGULATORY AGENCY**

### Content of Presentation

- Generators of HLW and LILW-LL
- Legal Framework
- Categorization of RAW
- Methods of Solid RAW Disposal
- Spent Nuclear Fuel
- High Level Waste - Kozloduy NPP
- Nuclear Applications - LILW-LL
- National Policy
- Strategy for SF and RAW Management
- Disposal of HLW and LILW-LL from Reprocessing of SF and Nuclear Applications
- Plan for Development of a National Geological Repository
- Geological Investigations for Geological Disposal

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**NUCLEAR REGULATORY AGENCY**

### Generators of HLW and LILW-LL

```

graph TD
    Kozloduy[Kozloduy NPP] --> RAW[RAW GENERATORS]
    Belene[Belene NPP in the future] --> RAW
    RAW --> IRT[Research Nuclear Reactor IRT-2000]
    RAW --> Apps[Nuclear Applications]
    
```

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Sofia, Bulgaria, 10-11 December 2007

**NUCLEAR REGULATORY AGENCY**

### Legal Framework

The RAW Management in Bulgaria is carried out according to:

- the **Act on the Safe Use of Nuclear Energy** (2002);
- the **Regulation for the Procedure for Issuing Licenses and Permits for Safe Use of Nuclear Energy** (2004);
- the **Regulation for Safe Management of Radioactive Waste** (2004).

[www.bnra.bg](http://www.bnra.bg)

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**NUCLEAR REGULATORY AGENCY**

### Categorization of RAW 1/2

```

graph TD
    Root["Disposal-orientated Solid RAW Categorization"] --> Cat1[Category 1 Transitional RAW]
    Root --> Cat2[Category 2 Low and intermediate RAW]
    Root --> Cat3[Category 3 High Level Waste]
    Cat2 --> Cat2a[Category 2a Short lived LLW]
    Cat2 --> Cat2b[Category 2b Long lived LLW]
    
```

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**NUCLEAR REGULATORY AGENCY**

### Categorization of RAW 2/2

- Liquid and gaseous RAW** shall be categorised depending on the properties of the solid waste, which are expected to be obtained after waste conditioning.
- Depending on the specifics of the applied methods for management of RAW, generators may introduce **additional categories**.

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**NUCLEAR REGULATORY AGENCY**

### Methods of Solid RAW Disposal

Category 1 Transitional RAW	Waste that can be disposed from regulatory control after appropriate processing and/or temporary storage for a period not longer than 5 years, whereas the waste specific activity reduces below the clearance limits.	No need of disposal
Category 2a Short lived LLW	LLW: Low level waste (solid) containing radionuclides with a half-life shorter or equal to that of Co-60 and long-lived alpha emitting radionuclides with specific activity less than or equal to 10 <sup>4</sup> Bq/kg, in a single waste package and less than or equal to 10 <sup>4</sup> Bq/kg for the whole volume of waste.	Near Surface or Geological Disposal Facility
Category 2b Long lived LLW	LILW: LLW containing long-lived radionuclides (with a half-life greater than that of Co-60) with a specific activity exceeding the limits for category 2a.	Geological Disposal Facility
Category 3 High Level Waste	Waste with such a concentration of radionuclides that heat generation shall be considered during storage and disposal.	Geological Disposal Facility

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**NUCLEAR REGULATORY AGENCY**

### Spent Nuclear Fuel 1/3

- The Republic of Bulgaria is oriented toward a fuel cycle, during which the activities of the initial (**fresh fuel fabrication**) and the final (**reprocessing of SF and the resulting waste**) stages are performed outside of the state territory.
- Spent nuclear fuel** is not treated like a RAW. According to the **Act on the Safe Use of Nuclear Energy** (2002) the **Council of Ministers** may declare SF to be **RAW** by a decision if there are conditions exist for safe storage and disposal of the SF in an appropriate repository and the operating organisation has paid a one-time contribution to the RAW Fund.

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## NUCLEAR REGULATORY AGENCY

### Spent Nuclear Fuel - Kozloduy NPP 2/3

- ❖ In accordance with the intergovernmental agreements for construction of Kozloduy NPP units, the former USSR has been obligated to accept the Kozloduy NPP SF on contractual basis.
- ❖ The last WWER-440 SF transfer to Russia upon the conditions of the previous contract **free of charge, without return of the HLW** was completed in 1988, after which the SF from Units 1 to 4 has been transported mainly to the **Wet SF Storage Facility** for temporary storage (3 to 5 years).
- ❖ In accordance with the new Agreement between Bulgaria and Russia from 1995, the transfer of SF for storage and reprocessing **with return of the vitrified HLW**, was re-initiated in 1998.
- ❖ Site selection and design permits and order for approval of the site for a **Dry SF Storage Facility** for the SF from the small Kozloduy NPP units were issued in 2004 and 2005. In 2009 it is expected that the new Dry Storage Facility to be commissioned.

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## NUCLEAR REGULATORY AGENCY

### Spent Nuclear Fuel - RNR IRT-2000 3/3

- ❖ The SF is stored at a storage facility of pool type (shaft storage), incorporated in the biological shield of the reactor.
- ❖ The **Strategy for Spent Fuel and Radioactive Waste Management** (2004) considers different options for safe transfer of SF from the site to a foreign country or to temporary storage at Kozloduy NPP site. The routes, transportation schemes, organizational, technical and financial aspects are reviewed in details for all variants. The variant with SF transfer for processing in Russia is considered as the most feasible. Negotiations for signing of the corresponding governmental agreement are currently underway. A joint project between Bulgaria, Russia, USA and IAEA on transfer of research reactor SF, within the framework of the US State Department Global Threat Reduction Initiative, is also currently underway.

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## NUCLEAR REGULATORY AGENCY

### High Level Waste - Kozloduy NPP

- ❖ The operational HLW are stored in **special shaft storage facilities located in the central halls of units 1 – 4 reactors and in the auxiliary auxiliary buildings of units 5 and 6.**
- ❖ To the recent moment there is **no returned HLW** from the **SF reprocessing**. The quantities of this kind of RAW will be the object of contract.
- ❖ The **HLW** from the **SF reprocessing** can be stored in the containers of the **Dry SF Storage Facility**.

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## NUCLEAR REGULATORY AGENCY

### Nuclear Applications - LILW-LL

- ❖ In the last few years, main part of the generated "institutional" RAW is **spent sealed sources**.
- ❖ At present, possibility for sealed sources disposal does not exist in the country; therefore, they are accepted (without prior processing, often in their original working containers) in the **Novi Han Repository** for **temporary storage** only.
- ❖ A **long-term solution** for this problem will be sought within the framework of the foreseen **National Disposal Facility for LILW**.

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## NUCLEAR REGULATORY AGENCY

### National policy

- ❖ The **Minister of Energy and Energy Resources** shall **implement** the **state policy** in the field of RAW management.
- ❖ The **Minister of Energy and Energy Resources** shall **elaborate** a **Strategy for Spent Fuel and RAW Management** and shall **organise** a **public discussion** of the Strategy draft.
- ❖ The **Council of Ministers** shall **adopt** this **Strategy** on a motion by the Minister of Energy and Energy Resources.

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## NUCLEAR REGULATORY AGENCY

### Strategy for SF and RAW Management

- ❖ The Strategy is **adopted** by the Council of Ministers **in 2004**.
- ❖ It is the **main document**, formulating the **strategic goals and tasks** in the RAW management, which are based on analysis of the present status and expert estimates of the future trends.
- ❖ This document includes the **schedule** for development of a **National Geological Repository for Disposal of HLW and LILW-LL from Reprocessing of SF and Nuclear Applications**.

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## NUCLEAR REGULATORY AGENCY

### Disposal of HLW and LILW-LL from Reprocessing of SF and Nuclear Applications

- ❖ According to the **Act on the Safe Use of Nuclear Energy** (2002) the **Council of Ministers** shall take any **decision** on construction of a **national repository** for storage and/or disposal of RAW.
- ❖ According to the **Strategy for Spent Fuel and Radioactive Waste Management** (2004):
  - It is foreseen that the **Concept for disposal of HLW and long lived waste in the country or in the regional/international disposal facility** as well as the **detailed investigation of the waste properties, geological limitations and existing conditions for storage construction** in the country will be completed until 2012;
  - The responsible organizations for the Concept are Ministry of Energy, Nuclear Regulatory Agency and Kozloduy NPP.

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## NUCLEAR REGULATORY AGENCY

### Plan for Development of a National Geological Repository 1/3

Development of a disposal concept, based on detailed investigations of volumes and characteristics of the waste, restrictions, concerning geological conditions for such type of facilities, and existing natural conditions for repository construction in the country 2005 - 2012

Assessment of the disposal concept, using available data from previous investigations as a basic information, and development of a national programme, including preliminary assessments of geological conditions for disposal 2012 - 2015

Decision of the Council of Ministers for construction of a National geological repository 2015

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## NUCLEAR REGULATORY AGENCY

### Plan for Development of a National Geological Repository 2/3

Establishment of a siting requirements and development of an overall plan for the site selection process	will be defined later
Site selection	will be defined later
Detailed investigations of the confirmed site	will be defined later
Licensing of the confirmed site	will be defined later

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## NUCLEAR REGULATORY AGENCY

### Plan for Development of a National Geological Repository 3/3

Design of the facility	will be defined later
Construction of the facility	will be defined later
Operation of the facility*	will be defined later
Closure of the facility	will be defined later

\* The expected commissioning of the facility is in 2100.

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## NUCLEAR REGULATORY AGENCY

### Geological Investigations for Geological Disposal 1/5

- ❖ at the end of 1970s - the first investigations involving the selection of potentially suitable areas for NPP RAW disposal were carried out.
- ❖ 1991-1992 - a Concept for a National radioactive waste repository by the Bulgarian Academy of Sciences (BAS) was developed. Selecting sites and rock systems, suitable for geological disposal has been carried out in two stages. The first stage includes a preliminary screening of the territory of the country on a 1:500 000 scale to select regions with suitable conditions for further investigations. At the second stage, 18 sites for detailed analysis have been selected in these regions. As a result, the sites composed of Lower Cretaceous marls in the Fore-Balkan, the Sakar granite pluton, and the gneiss and serpentinite massifs in the East Rhodopes have been determined as the most favorable for further investigations.

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## NUCLEAR REGULATORY AGENCY

### Geological Investigations for Geological Disposal 2/5

- ❖ 1995-1996 - the project was financially supported by the **NATO Science Committee**. A site-selection methodology for deep disposal in the **marl terrain** of Bulgaria was developed.
- ❖ 1996-1997 - the project was financially supported by the **PHARE programme**. The previous site-selection investigations have been analyzed, and a methodology for their continuation and expansion has been suggested.
- ❖ 1998-2000 - the project was financially supported by the **Ministry of education and science**. Selection of potential sites for geological disposal has been carried out.

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## NUCLEAR REGULATORY AGENCY

### Geological Investigations for Geological Disposal 3/5

- ❖ The main data for siting for geological disposal is taken from the projects completed during the period **1995-2000**. The total number of investigated sites is 47. Thirty sites have been selected using exclusionary (mostly geological) criteria. Final comparison of 30 potential sites led to choosing the following **four sites** for deep geological disposal: two sites composed of the **Lower Cretaceous marls** (Sumer and Varbitza formations) in northwest Bulgaria and two sites in the **Sakar granite pluton** in the southeast part of the country.

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## NUCLEAR REGULATORY AGENCY

### Geological Investigations for Geological Disposal 4/5

- ❖ **2002-2003** - the project was financially supported by the **Kozloduy NPP**. The aim was to evaluate the geological conditions for RAW disposal in the 25-30 km zone around the Kozloduy NPP. Preliminary geological, geomorphological, geological engineering, and hydrogeological explorations were carried out. The most interesting sediments from the perspective of geological disposal are the thick, spatially homogeneous **clayey marls**, situated at a depth of about 200-300 m to 1 100-1 300 m from the surface. These sediments include the Middle and Upper Paleogene and the Neogene formations - the **Deleina**, **Krivodol**, and **Smirnenski**.

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## NUCLEAR REGULATORY AGENCY

### Geological Investigations for Geological Disposal 5/5

- ❖ The site-selection procedure for geological disposal in Bulgaria is still at a preliminary stage, despite the progress achieved in site-selection work. The investigations corroborate the finding that the **Lower Cretaceous marls** in the north-west of the country are the best host rock for a geological repository. Next best are the sites located in the **Sakar granite pluton**. The **clayey marls** near the Kozloduy NPP is also desirable as a medium for a geological repository.

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## NUCLEAR REGULATORY AGENCY

**Thank you  
for  
your attention**

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### **Abstract**

The management of spent nuclear fuel (SNF) and radioactive high level waste (HLW) involves conditioning, transport, storage and geological disposal, with the overall objective of preventing the release of radionuclides to the biosphere over a very long time scale. Geological disposal is widely seen as the most realistic long-term solution. Much progress has been made in Europe over the past decades to develop such solutions. Although the responsibility for taking care of the radioactive waste lies with the individual Member State, it is obvious that the implementation of long-term solutions would benefit from working together. For the European Commission it is a priority that all Member States develop and implement long-term solutions for their radioactive waste.

Two European Commission projects were intended to explore different collaboration models in radioactive waste management, namely the projects SAPIERR-1 and -2 that looked into the possibility of establishing regional repositories, and the project CATT that explored the scope for shared management facilities and technology transfer between Member States.

This report summarises the events and conclusions of a workshop that intended to

- bring together the SAPIERR and CATT project partners, as well as other stakeholders, in order to explore the complementary aspects of the initiatives;
- facilitate the sharing of the main results of CATT and the interim findings of SAPIERR (which runs until November 2008), as well as the conclusions and experience from other organisations on Member State collaboration for waste management;
- discuss the state of knowledge and future needs and propose collaborations.

The workshop arrived at an agreed catalogue of issues and opportunities that can be used to shape future collaborative actions. This catalogue was developed in brainstorming discussions and included SWOT-analyses arriving at the 'pros' and 'cons' of the respective issues.

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